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## *Contents of This Issue.*





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# Who's Afraid?

When a man is taken sick all his friends are anxious to prescribe a remedy, each being sure that his particular nostrum would effect a speedy recovery. Most of these well meant remedies would only aggravate the disease, if taken; and if the advice of all were followed the patient would indeed need to have an iron constitution if he were not to succumb to their combined effects. The safest course is to "throw physic to the dogs," and take—COURAGE. This is the one remedy that can be always relied upon, and of which there is no danger of taking an overdose.

The country has been having a run of chills and fever, superinduced by fright; and the doctors of political economy of all degrees have each been urging their favorite panacea. These have run the whole gamut, from the heroic treatment prescribed by the socialists, to the simple suggestion of "rest and quiet." Fortunately few of the proposed remedies have been taken; and thanks to the vigorous natural state of its constitution, the country is in a satisfactory condition of convalescence.

What is wanted now is a liberal use of the one great restorer—COURAGE.

Those who fortified themselves by the application of this remedy at the beginning have come through with comparatively little trouble. The facts show that the lighting companies who "stood by their guns" and continued their efforts to secure and hold business, have at least held their own, while those who took fright at the first fire and deserted the field have suffered more or less severe losses.

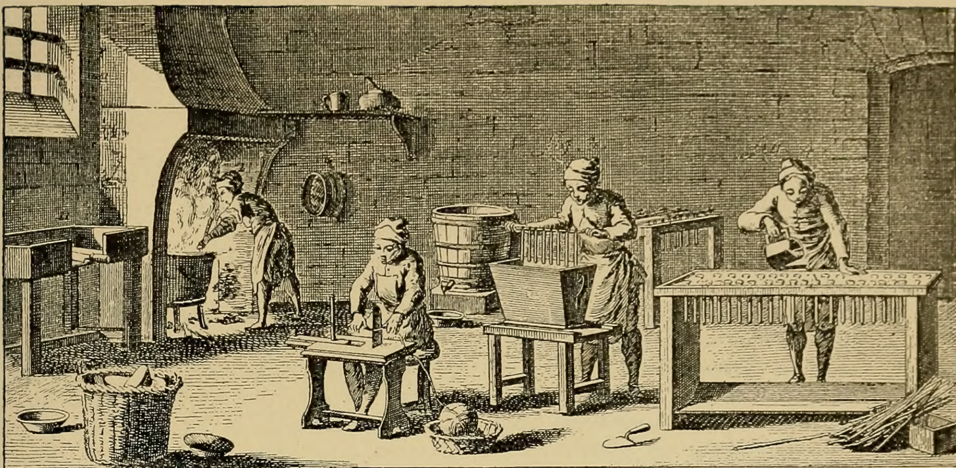
The same holds true in regard to other lines of business. In one particular case, instead of reducing the selling force and advertising appropriations when the scare came on, the manager "screwed his courage to the sticking point," and increased both. Result—the business of the company has been increased 50 per cent. over the corresponding months of last year, and this during the panicky times just passed.

What often passes for the virtue of conservatism is in reality only the vice of cowardice. This country as a whole is too sound, too sensible, too progressive and too fearless to back-slide in its prosperity for any considerable length of time; and occasions of retrogression only offer exceptional opportunities for the courageous and the persistent to place themselves far in advance of their more timid competitors in the race.

"Fools rush in where angels fear to tread," and thereby secure most of the orchestra seats at the celestial concerts. The present time is rich in possibilities to the courageous and the far-sighted.

Faith is the "substance of things hoped for"; the business man of to-day who has faith in the ultimate greatness of our country, and backs this faith by the courage of his convictions, will reap a rich reward of that substance, the love of which is said to be the root of all evil, but the actual possession of which is the basis of all positive good.

E. L. Elliott.



# The Magnitude of the Lighting Industries

By E. L. Elliott.

Artificial lighting ranks third in order of importance among the necessities of civilization, being superseded only by clothing and shelter. That the industries connected with the production and use of light should therefore present a large aggregate is readily apparent; and yet the real magnitude of these enterprises is doubtless far beyond the conception of those who have not had their attention particularly directed to the subject.

At the present time the production of artificial light can be divided into the following distinct classes: Candles, oil lamps, illuminating gas, electricity, and acetylene. This enumeration is in the order of their development. A candle is often used to symbolize an epoch, or a means of doing things, that has long since passed away; and it will doubtless come in the nature of a surprise to many to learn that the candle industry in this country at the present time is larger than it has ever been before, and is increasing regularly at the rate of about 10 per cent a year. This increase of course is due primarily to the large increase in population, which increases the total output of any commodity in general sale; but aside from this there are two factors to which the increasing popularity of the candle is largely due. The first of these is its use in religious celebrations. This use has come down from extremely ancient times, and is likely to persist for centuries longer. The use of candles in the rites of Catholic Churches is a familiar fact to Protestants; but it will surprise many Christians of all faiths to learn that the use of candles forms an important element in the rites of the Jewish religion. For religious purposes candles are frequently made of enormous sizes. Mr. W. J. Calkins, the head of the candle department of the Standard Oil Company, to whom we are indebted for most of the information which we give on this subject, states that they have made candles 10 feet high, and capable of burning continuously for several years. From these giants the sizes and shapes vary through all dimensions down to a minute taper less than an inch long, and a quarter of an inch in diameter. Candles were formerly made in connection with the soap industry, but at the present time paraffine, a product of mineral oil, is

15457

the principal constituent, and hence their manufacture has been entirely separate from its original connection. The two materials used in the manufacture of candles are paraffine and stearin. The latter forms the principal portion of tallow, and has a considerably higher melting point than the former. The composition of candles is varied according to the climate in which they are marketed. Thus, for the southern markets a considerable portion of stearin must be used in order to make the candles withstand the natural heat without softening so as to bend or run down; while for the northern markets pure paraffin can be used; and for intermediate sections proportionate compositions. The pure tallow candle is practically a thing of the past, there being only one small manufacturer of such candles still doing a limited business in New York.

On account of the sentiment connected with its historical associations, as well as upon its very soft and small amount of light, the use of candles is increasing for decorative purposes. As a Christmas tree decoration, the candle is indispensable, and for the purpose of supplying the demand for such candles the Standard Oil Company alone runs three factories continuously the year round.

Aside from its use for religious and decorative purposes, the candle still finds favor for general purposes on account of its convenience and extreme portability. A statement of one of the great electrical inventors, which has been so often quoted as to doubtless be familiar to the reader, is to the effect that had the electric light existed for centuries, and the candle were to be newly discovered, it would be hailed as one of the greatest inventions of the age, being entirely self-contained, cheap, and extremely portable, and requiring no accessories in the way of chimneys or shades.

From their New York office alone the Seandard Oil Company last year sold over 4,000,000 pounds of candles, while their total sales reached 30,000,000 pounds. The estimated value is 10 cents a pound, which gives an aggregate of $3,000,000. This represents, according to Mr. Calkins, about a third of the entire product of the country, so that a fair estimate of the total amount of candles used per year is 100,000,000 pounds, having a total value of from ten to twelve million dollars.

The manufacture of shades and candlesticks and candlebra is also an industry of considerable proportions, and one which is increasing at a fairly rapid rate. It has been impossible, however, to obtain any accurate figures, owing to the fact that the manufacture of such goods is one of the items among more general lines of manufacture.

The oil lamp, or as it is more familiarly known, the kerosene lamp, furnishes almost exclusively the light for the farmers, and the inhabitants of villages and small towns at the present time. Before the discovery of petroleum in commercial quantities, the problem of light for this large class of consumers had begun to assume a serious aspect. The practical extinction of the sperm whale, which had been a source of illuminating oil in the years preceding, was already in sight, and there was no other immediate source which promised to furnish an available burning oil at a reasonable price. The drilling of a single experimental well in northwestern Pennsylvania in 1837 revolutionized the whole situation at a single stroke. It demonstrated that there was an entirely new source of supply; the extent of which could not even be surmised, but which was available in perhaps almost inexhaustible supply at a far less cost than attendant upon the production of illuminating oils which it was to supersede.

Petroleum had been known in Pennsylvania for many years previous to the putting down of this first well. It had been observed floating upon the surface of certain streams, and the census of 1810 reports the production of 550 gallons of this "spring oil" in Venango County. In 1890 there were 94 companies engaged in refining petroleum, having an aggregate capital of $77,416,290, and turning out an annual product valued at $185,001,198. In 1900, there were 67 companies, capitalized at $95,327,892, and turning out an annual product valued at $123,929,384. In 1899 there were produced 25,171,289 barrels of illuminating oils valued at $74,694,297. Assuming that the illuminating oils have the same general ratio to the entire pro-

duct of the refineries as shown in 1890, the value of illuminating oil produced in 1900 would be $100,000,000, and if the production has increased at the same rate, the present annual value of illuminating oil would be $133,000,000.

The illuminating gas industry in this country dates from 1806, at which time David Melville, of Newport, R. I., lighted his premises by means of coal gas which he manufactured. This was nine years after the first experiments in England. Melville kept on improving his apparatus, and secured a patent in 1813, and later introduced gas lighting into a cotton mill in Watertown, Mass. New York City adopted gas lighting in 1823. Since that time the industry has been threatened with extinction by two strong competitors, namely, kerosene oil and the electric light. It has not only survived the competition thus introduced, but has shown a continuous growth up to the present time. At the time of its first introduction, illuminating gas was sold in New York at $10 per 1000 feet. At the present time, the average price of gas throughout the United States is probably not far from $1 per 1000 feet.

In 1890 there were 742 companies engaged in furnishing gas, with a capital of $258,771,795, and an annual product valued at $56,987,290. In 1900 there were 877 companies with a capital of $567,000,506, and products valued at $75,716,693. At the same rate of increase the annual value of the productions of the gas industry at the present time would aggregate $80,000,000. This includes all the gas used for heating, cooking and lighting purposes. The best information obtainable gives the proportion used for lighting as 75 per cent., which would give a value of $60,000,000 as the annual value of illuminating gas.

The exact figures representing the capital invested, and annual production of electricity generated for illuminating purposes are impossible to obtain, owing to the fact that in the majority of stations at the present time current is sold for power and other purposes. In 1902 there were 3,620 central stations, the cost of construction and equipment of which amounted to $504,740,352, whose gross income was $85,700,605. These supplied 385,698 arc lamps, and 18,194,044 incandescent lamps. No authentic figures are available as to the amount invested in private isolated plants, but it is generally assumed, and doubtless with a fair degree of accuracy, that their total product is about equal to the product of the central stations. It is assumed by competent authority that there has been a 20 per cent. increase in the output since the compilation of the figures given, thus bringing the annual product of the central stations to practically $100,000,000. It is also fair to assume that 75 per cent. of this total is devoted to the production of light. We thus arrive at the round figure of $75,000,000 as the present annual expenditure for electric current produced by central stations for generating light; and assuming that the current privately generated is equal to this, we have the total of $150,000,000 as the annual value of electricity used for lighting purposes.

Of the industries engaged in the production of lighting apparatus, those in the electrical field represent the largest investment of capital and value of product. In 1905 there were reported 195,157 arc lamps produced, having a value of $1,574,422. The number produced during the past year probably was close to 200,000. In the same year there were produced 112,711,558 standard incandescent lamps; 1,584,495 miniature and decorative lamps. The value of the standard lamps was $6,308,294, and of the miniatures, $544,906. The value of this product was practically double that of the value of 1900; but the increase in the number of lamps during the same time was practically four times. It is conservative to estimate the increase in production and value since 1905 as 25 per cent. a year, which would bring the total during the past year up to 168,853,869 standard lamps, and an aggregate value of $10,429,307.

In 1905 there were 784 establishments engaged in the manufacture of electrical apparatus and supplies, having a capital of $174,066,026, the annual value of whose product was $115,730,089. The value of the products shows an increase over 1900 of a little more than 10 per cent a year. On the same basis of increase the present

value of the products would be $138,-876,105.

The manufacture of lighting fixtures is an industry of large proportions. There were reported in 1905, 263 establishments making gas and lamp fixtures, having a capital of $20,206,975, and turning out a product valued at $17,560,386. In the same year electric lighting fixtures, including sockets and receptacles, etc., were valued at $5,304,466.

Of apparatus connected with oil lighting there were manufactured in 1900 807,-765 dozen glass lamps, valued at $1,498,-675; and in the same year the lamp chimneys made were valued at $2,719,583, and the lantern globes at $497,021. Allowing for increase the present value must be about $3,500,000.

In 1905 the value of lamps and reflectors, which included metal lamps and their accessories, was $8,999,874.

We may then tabulate the several amounts, given in round numbers, as follows:

Annual Value of Illuminants.

| | |
|---|---|
| Candles | $11,000,000 |
| Kerosene | 133,000,000 |
| Illuminating gas | 60,000,000 |
| Electricity | 150,000,000 |
| Acetylene (estimated) | 6,000,000 |
| Total | $360,000,000 |

Lighting Apparatus.

| | |
|---|---|
| Electrical Supplies | $139,000,000 |
| Electrical Lamps | 12,000,000 |
| Fixtures | 18,000,000 |
| Lamps and accessories | 13,000,000 |
| Total | $182,000,000 |

Taking 90,000,000 as the present population of the United States, we find that, according to the above figures, the cost of luminants for one year is equivalent to $4 for every man, woman and child. To say that 10 per cent. of the light generated is wasted through misuse and ignorance is certainly a conservative estimate; this gives $36,000,000 as the total amount of loss from this source, or an average of 40 cents per capita for the entire population of this country. Aside from candles and kerosene oil, the waste is probably nearer twice this amount. If all items could be included which pertain to the lighting industry, it appears likely that the grand total of expenditure per year would reach half a billion dollars. A portion of this, however, is in the line of permanent investment.

# Street Lighting in the United States During 1907

By H. Thurston Owens.

The general interest in the subject of Public Street Lighting, has shown the same remarkable growth during the past year as has the interest in interior illumination.

The subject has been before nearly all of the several sections of the Illuminating Engineering Society, and the discussions have very forcibly made the fact apparent that the subject is in its infancy.

The conditions in the average American city are not so favorable for good street lighting as those of European cities. The unsightly poles, the overhead wires, and poor reflecting surfaces of buildings being much more in evidence in the former than in the latter; and the success with which a city lights its streets is a more striking example of its progressiveness than the number of its schools and libraries.

However, when a city does arrive at the conclusion that they are "behind the times," they proceed to "whoop things up" with a vengeance, with often curious results; the usual one is that several of the downtown streets are lavishly lighted and the rest of the city very inadequately lighted—notable examples being Los Angeles, Cal.; Denver, Colo., and Buffalo, New York.

One of the most promising features of this so-called "spectacular lighting" is the fact that the illuminant is generally selected on account of the quality of the light, and the posts and fixtures are usually "things of beauty."

There are a number of types of lamps which have found favor in this country for use in public street lighting, and usually several are to be found in each city.

Every city of over 30,000 population uses arc lamps, which is true of no other form of lamp, although the mantle gas lamp easily ranks second.

For the purpose of comparison each illuminant will be dealt with separately.

### Oil Lamps.

Oil lamps are relics of the past, although quite a large number are still in use. Where electricity and gas were not available their use was a necessity, but now that mantle naphtha lamps can be obtained for a reasonable price, they are rapidly being replaced by this modern and many times more efficient light-source.

### Acetylene Gas Lamps.

What is said of gasoline gas lamps is applicable to acetylene gas lamps, although the latter are equipped with open flame burners. They greatly outnumber the former, and their use is increasing much more rapidly.

### Open Flame Naphtha Lamps.

Naphtha lamps with open flame burners are not as old as the oil or kerosene lamps, and are rapidly being replaced by the mantle type.

### Gasoline Gas Lamps.

Gasoline gas lamps are naturally all located in very small towns and villages. None of the installations are of large size, although in the aggregate they add considerably to the total number of public street lamps. They are generally equipped with mantle burners and boulevard globes.

### Mantle Naphtha Lamps.

The mantle naphtha lamp has a field which is quite its own. The quality and quantity of the light equals the mantle gas lamp, although at a slightly higher cost. The design of these lamps is the equal in appearance to gas mantle lamps, and in fact one is not readily distinguishable from the other. In cities where there are a large number of alleys they can be used to great advantage. There are over 5,000 used in this way in Philadelphia alone. But it is in parks, where wires and pipes either overhead or underground are not desirable, that this lamp is used to the best advantage, and the past year has seen a large increase in the number of them in use for this purpose.

### Open Flame Gas Lamps.

Open flame gas lamps for street lighting have been replaced by mantle lamps even more rapidly than similar lamps for interior purpose. There is one very large installation of such lamps in use in Philadelphia, consisting of over 22,000 lamps, but the conditions under which they are maintained are peculiar; they are one of the items included in the much talked of "gas franchise" granted to the Gas Company, and these lamps are furnished free.

It is a peculiar coincidence that the home city of the largest street lighting contracting company in the world should use open flame lamps.

The most noteworthy feature of the past year regarding this type is that they have decreased in number, and it is only a question of a very few years when they will be done away with entirely.

### Mantle Gas Lamps.

Mantle gas lamps rank next in number and popularity to electric arc lamps, and their use in connection with the latter type seems to be the natural trend in cities of any size. Two very good examples of this are New York and St. Louis; and incidentally the lighting found in those cities is not surpassed in this country. The mantle gas lamp has a number of features which place it far above its rivals, namely: economy, low intrinsic brilliancy, and the pleasant quality of its light. It must be maintained in good condition, however, by skilled workmen, and the piping kept in perfect condition, as otherwise the results are far from satisfactory. The troubles from frost and naphthalene are probably the hardest to contend with. Mantle gas lamps are always staggered, that is, placed upon alternate sides of the street, and *that should always be done with small units*. There is no standard lighting fixture in use in this country whose appearance compares with the gas lamp post equipped with the "boulevard globe." There may be some small installations of "Electroliers," (which, by the way, is bad English) and some larger installations for

special purposes, but the average incandescent electric equipments are makeshifts by comparison. Mantle gas lamps are usually maintained by an outside contracting company, but one installation which has been handled successfully by the gas company was unique, inasmuch as the mantle gas lamps which were installed replaced electric arcs and incandescents.

### Inverted Mantle Gas Lamps.

Inverted mantle gas lamps are working such a revolution in interior lighting that it is natural to suppose that their influence will be quite noticeable when they are exploited for outside uses. The manufacturers have quite wisely delayed their introduction until there could be no reasonable doubt regarding their success. The large number in use in Great Britain seem to have given great satisfaction, but none have been installed here as yet. A comparative test between tungsten electric lamps and inverted gas mantle lamps is now under way in Grand Rapids, but the results are not available at present.

### Incandescent Electric Lamps.

Electric incandescent lighting has never received the attention which it deserves, and that is one of the reasons why it has not been used more extensively. "Nominal" 25 c.p. lamps hung upon unsightly poles, usually being attached by means of a reflector, which soon becomes rusty, are not conducive to the comfort and well-being of a community. They do not even have the advantage of being cheap, for over twice the illumination could be obtained by means of either mantle gas, or mantle naphtha lamps for the same outlay. During the two past years, the lamp manufacturers have attempted to cut down the advantage of their successful opponent by increasing the efficiency of their product. One of the results has been that the "metalized" filament lamp is now used quite as extensively as the old carbon lamp.

The tantalum lamp has not been manufactured for street series circuits up to the present time, and is not likely to be, as a still more efficient type, the tungsten, is being exploited.

### The Tungsten Electric Lamp.

This lamp is receiving the benefit of liberal advertising, and its use here was not begun until it was found to be successful abroad. Its efficiency is astonishing compared with the old carbon lamp, and its attendant bad features are rarely mentioned. It is being sold for use anywhere and everywhere, and has not been used as yet with enclosing globes. The intrinsic brilliancy of this lamp is very high, and that reason should be enough to make the use of globes necessary. There are further reasons why this would be a good thing to do, because by improving the appearance of the unit it will sooner be recognized as a first-class illuminant. The manufacturers claim that the 40 c.p. lamp is equal to the mantle gas lamp burning 3½ feet per hour, of nominal 60 c.p., and have succeeded in disposing of a number of the lamps on this basis. The largest installation to date is some 700 lamps, but this is an exception, for the lamp is in an experimental stage at present, although it is probably destined to be used quite extensively in the future.

### The Nernst Lamp.

The type of Nernst lamp in use is a 115 watt 4/10 ampere, and is used on series A. C. circuits with individual transformers. It is rated at 50 c.p., this being its maximum intensity at 25 degrees below the horizontal; from the horizontal to 15 degrees below it is only 40 c.p. The reason why this type of lamp has not been used to any great extent, is principally the expense involved in the original installations.

### Electric Arc Lamps.

There are more electric arc lamps in use for street lighting in this country today than any other single type of light-source, and the reason is not their superiority. They were well advertised, and they "took." People wanted bright lights equal to "2,000 candles." The tide is now beginning to turn, for they have not been satisfactory for the lighting of residence districts. In the cities where the facts have been realized and the money available, they have been removed, and either incandescent or mantle gas substituted. Several hundred arcs were removed from residence streets in New York alone during the past year. A question of politics rather than illumination brought out a number of interesting points regarding street illu-

mination in what is now known as the Colorado Springs Controversy, where 6.6 ampere A. C. arcs were supplied by the electric company, under a contract calling for a "standard 2,000 c.p. lamp." The matter was decided by arbitration, a noteworthy incident in itself, and the city obtained an award of damages.

Electric arcs give by far the best value for the money when used in business districts, where good reflection from buildings is obtained, and on account of the small number of poles necessary, there is little interference with trucking. They furnish practically all of the illumination in these sections of the large cities and probably will continue to do so.

### Luminous Arc Lamps.

The increase of this type lamp has not continued as rapidly as might be expected, for its current consumption is low, its period of burning long, and its distribution of light far superior to the enclosed carbon arc. It is a very efficient form of lamp for street lighting, and undoubtedly one which will be used quite extensively in the future. The drawbacks at the present time are, that it is an expensive lamp to install, and has not been perfected.

### The Flaming Arc.

The flaming arc has fortunately not made much headway in this country for use in regular street lighting. The pink color is attractive, but the lamps generally flicker badly, and the large volume of light is very bad for the eyes. It has been proposed to install these lamps in the business district of Chicago, about 50 feet apart, but this would entail too great an expense, so the matter has been dropped for the present. We are behind our British cousins in the use of these lamps, for they have been used quite extensively by them. A recent installation in London, where the lamps were hung 100 feet apart and 28 feet high, suspended by wires, has been commented upon quite generally in the technical press. (See *Electric Review*, Jan. 4 and Feb. 15, 1907.)

### Ornamental Public Lighting.

The interest in the ornamental features of lamps and fixtures has continued to increase, with the result that at least one large installation has been completed, and a number of others started. It is indeed fortunate that this is the case, for it is highly important that cities should interest themselves in the matter. At a meeting of the Chicago Section of the Illuminating Engineering Society, one of the members stated that a lamppost was an "ugly thing at best," and there was a time when it was necessary to journey abroad to disprove that statement; but there are a number of handsome installations in this country at the present time. In St. Paul, Minn., a large installation was completed during the past year. A feature of this installation which deserves greater praise than has been accorded, is the pendant position of the globes. Globes are rarely hung in this position when used for this purpose, although there are many evident reasons why they should be so hung. Denver, Colo., has found that ornamental lighting pays, and preparations are under way for additional lighting of this character. The fixtures to be used in the new installation are not as heavy or as elaborate as those in use, but are of equal artistic merit. In San Francisco, Cal., a combined trolley and lamp post is also to be used. Plans are now under way for ornamental lighting in St. Louis, Mo., and Philadelphia, Pa. The only illuminants which have found favor for this purpose are incandescents and arcs, although there is no apparent reason why mantle gas lamps could not be used.

### Prismatic Glassware.

Enclosing globes which improve the distribution as well as the appearance of a light source are not used in this country to any extent. In Spokane, Washington, a number of merchants have equipped their own private posts with Holophane "bowl" reflectors. In Washington, D. C., the incandescent lamps surrounding some of the monuments are equipped with spheres and hemispheres. The failure to use this style of glassware is in great contrast with the many installations to be found abroad. A globe has recently been perfected which gives a distribution of light in a horizontal plane up and down the street where it is needed, and is especially adaptable for the new high-efficiency lamps, such as the tungsten.

# Progress in Inverted Gas Lighting in 1907

By T. J. Litle, Jr.

During the past year the inverted gas light has been brought forcibly to the attention of the American public. While at first it was looked upon as a novelty in gas lighting, its principal merit apparently being in that it had great decorative possibilities, its practical value from an economic standpoint, however, was soon recognized, and it was due to this knowledge on the part of lighting companies that led to the adoption of the inverted gas lighting system for commercial and private lighting. It seemed indeed strange that history should repeat itself by giving simultaneously to the gas and electric lighting interests inventions of great economic value. I refer to the introduction of metallic filament electric lamps (tungsten and tantalum) and the inverted gas burner.

If we look back a little we will find that about the time Edison introduced his incandescent electric lamp, which threatened to very seriously compete with the old style of open gas flame, Dr. Carl Auer von Welsbach invented the incandescent gas mantle. Or again we might compare the development along slightly different lines by stating that the flaming electric arc lamp, which has been introduced during the past couple of years, had been experimented with fifteen or more years ago, the idea being at that time to introduce some material into the carbon that would enhance the brilliancy of the arc. The early experimenters, however, were not successful and the scheme lay practically dormant until within the last few years, when new experimenters revived the art.

We have this same peculiar condition in the development of the inverted incandescent gas burner. We find that Clamond, in the year 1882, describes an inverted incandescent mantle, which, however, was not made of the same material as the modern mantle; namely, thorium and cerium, but rather in the form of a magnesia basket. It was not practicable, due not only to the fact that the incandescent medium was not satisfactory, but also to the fact that the burner construction was faulty; and so we find that this very valuable invention was placed on the shelf until modern investigators revived the early art by modifying the modern form of upright mantle construction so that it would burn in an inverted position.

The high efficiency of the inverted light is due to the advantageous placing of the mantle below the burner in a pendant position, with nothing below to obstruct the light, and a more complete aeration of the external surface of the mantle, thus increasing the surface combustion. As a result of the higher surface combustion it is found that the surface of the mantle may be materially reduced over that of the upright mantle, a very great advantage, particularly from the standpoint of mantle-durability, in that the larger the mantle the weaker it is, for it must be remembered that a mantle is nothing but an ash, which, for example, may be compared to the ash of a cigar. Consider a cigar having an ash 2 inches long and you will find that it must be held very steadily for the ash to cohere; but on the other hand, a short ash has considerable strength and the cigar may be shaken with considerable violence before it drops off; so that the smaller the mass of the mantle the greater its strength. Now it is pretty well known that the life of an upright mantle is limited directly by its ability to withstand shocks, and we find that to be true in practice. It has been found that the already large amount of useful illumination given by the inverted mantle can be greatly augmented by the use of properly designed reflectors and to show the extent to which this can be carried we have designed concentrating reflectors which when used with a single inverted mantle project a light equal to 600 candles directly below. I make this statement not so much with the idea of recommending the powerful pencil-beam reflector as I do with the idea of showing that

the mantle itself is of such a shape as to be admirably adapted for the purpose of reflection. All of this has been already treated in various articles appearing in THE ILLUMINATING ENGINEER for April, 1907, p. 756; Sept., 1907, p. 538; Nov., 1907, p. 667, and Dec., 1907, p. 721.

From the commercial standpoint the inverted gas light has been a boon to the gas companies, in that it has enabled them to procure lighting business which before was unobtainable with the use of the upright incandescent burner. This is particularly true in lighting of the higher class shops in the larger cities. The wonderfully high lighting efficiency of the inverted gas lighting system was not alone responsible, but the artistic design of the burners and glassware in combination with special fixtures contributed largely to their successful application.

Furthermore, a campaign of education has been inaugurated by the Welsbach Co. in the form of printed bulletins, whereby the basic principles of gas illumination has been very clearly set forth and the newer developments carefully noted, together with the efficiency of the various types of incandescent gas appliances now on the market.

During the past year we find a large number of gas companies extending the campaign of education along the lines of practical illumination, by organizing their sales and appliance departments and holding monthly and semi-monthly meetings. I have attended quite a number of these meetings and from what I have observed I believe they will ultimately result in greatly raising the standard of artificial illumination. These meetings are not composed of gas men alone; I have attended meetings where the same corporation has control of both the gas and electric interests and the spirited discussions have contributed largely to the fund of information, and in this campaign of education we find the illuminating engineer occupying a very conspicuous position, for he it is who must recognize the proper adaptation of this system of inverted gas lighting and must know its relative advantages over the older systems, both in economy and more favorable adaptation, and also be able to impart this knowledge to the army of solicitors employed by the new business departments of the 1800 gas companies in this country.

To substantiate my statement that the inverted gas mantle if adapted for conditions which would not warrant the use of the upright form, I quote from a paper read by Mr. R. M. Dixon, President, Safety Car Heating & Lighting Co., on Car Lighting, before the American Society of Mechanical Engineers in January, 1907: "There are at the present time in North America 33,000 railway coaches equipped with inverted mantle burners."

I have also noticed inverted gas lamps in use in freight and passenger elevators, where it would have been folly to have used upright mantles. In machine shop practice it is now pretty well conceded that the inverted mantle furnished an ideal illumination. From the fact that a large volume of light may be thrown directly upon the work, and with the various types of reflectors the operator can perfectly shield his eyes, the illumination thus obtained has in every case been greatly appreciated by the user to such an extent that I think I may safely say that the 16 and 20 c.p. electric units have been relegated to the past. I know there are some who will dispute this statement, but from actual observation I have noted the favorable reception given the inverted gas burner where it has been placed on trial over machines and work benches and the highest authorities state that eye strain is due as much to insufficient illumination on the work as it is to the presence of unshielded lamps.

In adapting inverted gas lights to shop practice it has been found that the best results have been obtained when the lamps were suspended from flexible metallic tubing attached to overhead swing brackets, which enables the lamp to be swung through quite a large horizontal arc in order that the light may be placed at one side or the other of the work at hand.

It might be assumed that gas lighting of modern factories would not be feasible from the fact that a great many shops generate their own electric power. While this may be true in some places there are a great many instances where gas lighting not only gives a superior illu-

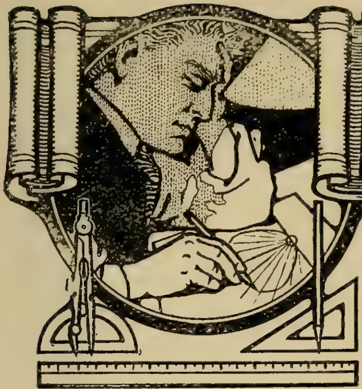
mination but also proves more economical. For instance, in the medium sized shop they frequently have their power plant greatly overloaded, particularly during the lighting hours. A power plant works at its maximum efficiency only at full load, and other things being equal the power plant in a modern factory is only working its maximum efficiency a couple of hours per day only, that is, during the lighting period. At other times the plant must be operated at a reduced efficiency which must be (but seldom is) reckoned with when the cost of electric lighting is taken into consideration. On the other hand if the plant is operated at its maximum economy during the day it is heavily overloaded during the lighting hours, with consequent insufficient power either for driving machinery or dynamos, which always results in poor service. This is so true in a number of instances that the electric light people have succeeded in closing down the private plant and selling current from the central station, thus delivering it with less variation and a consequent increased lighting efficiency and greater satisfaction than the manufacturer can hope to produce himself.

Now that being true it must be admitted that the chances for the introduction of gas lighting into factories are infinitely greater than ever, for it has been pretty clearly set forth that for a given expenditure a great deal more illumination can be obtained with gas than with electricity in any form.

The progress in store window lighting has been clearly set forth in previous articles and but little can be added, except that the inverted lamp, as already stated, has enabled the gas company to get business which before had been considered unobtainable by the gas interests.

The lighting of the home, after all, is the great problem which continually demands our undivided attention and the reception here given the inverted gas burner has been truly phenomenal, the light distribution being considered almost ideal and decorative glassware can be used without interfering with the useful distribution.

Gas lighting has always been handicapped by the necessary use of matches for ignition, but this has been eliminated by the use of self-lighting attachments used in conjunction with the lamp, which enables the lamp to be lighted or extinguished by the simple pulling of a chain. Lamps can also be lighted from a distance by the use of recently perfected pneumatic lighters, whereby the pulling or pushing of a small button attached to a miniature pump, which is connected with a piston valve at the burner by means of small sized metal tubing, known as hollow wire, ignites or extinguishes the light. Where a number of lights are to be lighted simultaneously the electric jump spark system has been successfully applied; in such places as show windows, stores, churches, public halls, bowling alleys, etc. So much for the progress during 1907, which has of course been introductory to the ultimate success of the inverted gas lighting system. We may expect far greater progress this year, as we are out of the experimental stage and on a practical working basis, and the inverted arc light, which to me seems to embody all of the desirable features of the individual inverted burner, will soon be placed on the American market which for larger areas of lighting, coupled with the convenience of operation and handling and trimming, will be all that could be desired.



# Practical Problems in Illuminating Engineering

## The Lighting of a Shoe Store

By Norman Macbeth.

The order for engineering of the illumination and installation of fixtures in the new Regal shoe store, 1226 Market Street, Philadelphia, was given with the understanding that same would be completed within ten days. The wiring had been completed and the architect had left the entire matter of lamps to be used and fixture design, with the exception of the central light in the windows and doors, to the fixture concern or contractor. One circuit was allowed for each of the four outlets in the main store with three outlets in the ceiling of the rear addition, the central one of which has not been used. The windows were marked on the plans with an allowance of 6-16 c.p. equivalents for each, with 6-16 c.p. allowance additional to be used in the center of the ceiling within a ring of beaded fringe.

Each of the windows were alike, being 7 feet high from floor to center of lamps with 5 feet distance to rear sash. The calculation was simplified by determining the lamps and reflectors desirable, rather than by the usual method of making calculations on several reflectors and leaving the choice finally to guess-work. We determined the heights and distances for regular angles with readings of candle-power intensities for uniform horizontal and normal illumination. Desiring to use an 80 c.p. tungsten lamp we have found for windows of this character, for the display of shoes, that 12 mean spherical c.p. (approximately 150 lumens) per square foot of floor surface, with a distribution accessory which will efficiently re-direct the flux of light at the proper angles will give maximum brilliancy beyond which the eye does not detect the difference. This approximation takes care of the number of lamps to be used, the spacing being arranged with special attention to the extreme ends and corners of the windows, keeping down the building up of illumination in the center.

To determine the reflectors to be used, a theoretical polar diagram is plotted from values as read from the disc calculator, shown on page ? Setting 3 foot-candles, the illumination desired from one light-source, on height of 7 feet, and reading

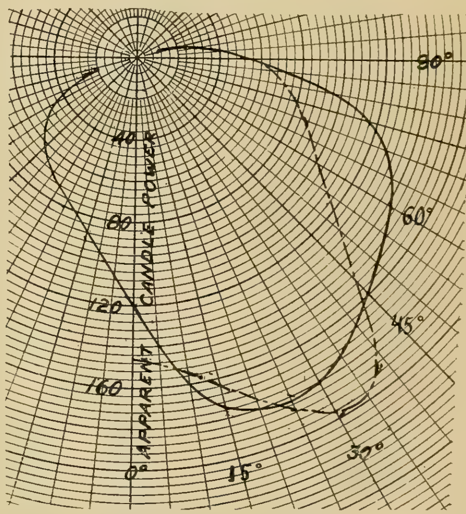



FIG. 1.—DISTRIBUTION OF NO. 70 D'OLIER REFLECTOR WITH EXTENSION SHOULDER, 100-WATT TUNGSTEN LAMP. DOTTED LINE SHOWS DISTRIBUTION REQUIRED.

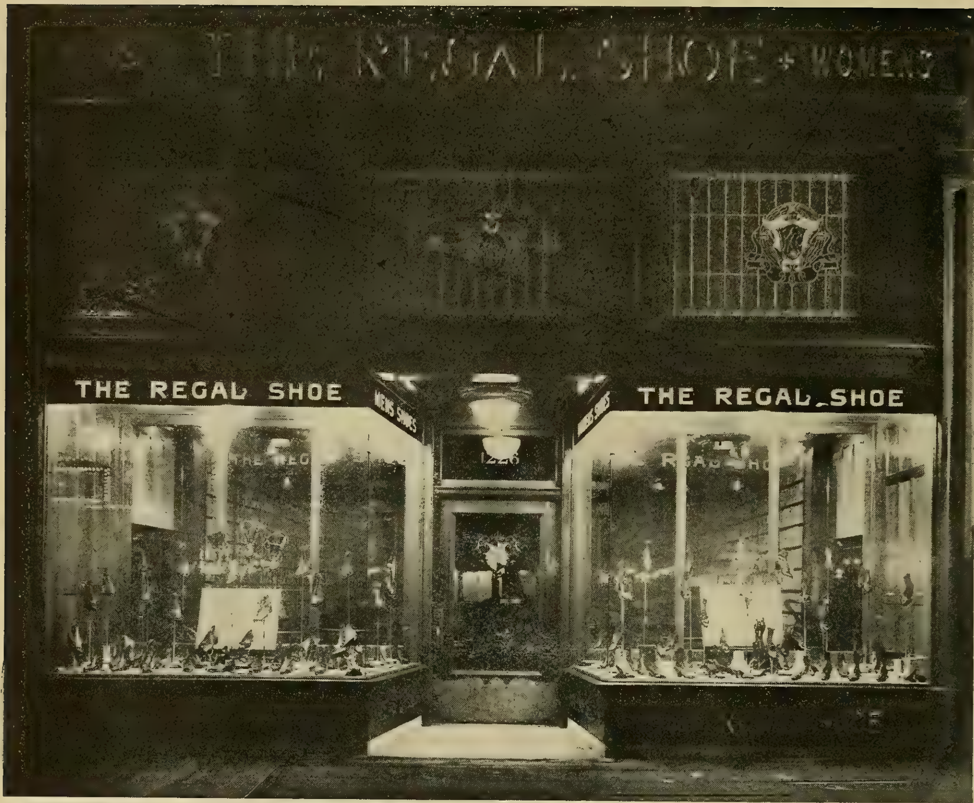



FIG. 2.—SHOW WINDOWS, REGAL SHOE STORE.

c.p. for horizontal intensities from 0° to 20° and at all other angles the normal values; the depth of the window being 5′, a 5′ height must be used for 45° and distance thereafter remaining constant at 5′, the various heights may be read, giving 2.89′ for 60°, 1.34′ for 75°, and .88′ for 80°, or as expressed below with c.p. intensities.

| *Angle.* A | *Height.* H. | *Distance.* D. | *Intensity.* C.P. |
|---|---|---|---|
| 0° | 7′ | 0 | 147 |
| 10° | 7′ | 1.23′ | 154 |
| 20° | 7′ | 2.53′ | 177 |
| 30° | 7′ | 4.05′ | 196 |
| 45° | 5′ | 5′ | 150 |
| 60° | 2.88′ | 5′ | 100 |
| 75° | 1.34′ | 5′ | 80 |
| 80° | .80′ | 5′ | 77 |

The resultant of curve is given plotted over a curve made by the electrical testing laboratories on a No. 70 D'Olier reflector with extension shoulder, and an 80 c.p. 100-watt tungsten lamp. The light from the back of this reflector was particularly necessary to properly illuminate the sign transparency above in Fig. (windows).

We hope at some later time to take up the results of these windows with an illumination photometer. One reading in the rear of window gave 8.6′ candles, which should represent the minimum, owing to the windows being dressed; we were unable to secure other measurements.

The light shown in the center of the window ceiling is surrounded by a 6-in. ruby cut bead fringe and did not enter into the window illumination calculation. One lamp in a distributing Holophane reflector No. 6060 set above the deck, was used only to brighten up the beads. In the doorway one No. 1611 Class A Holophane hemisphere is used with an 80-c.p.

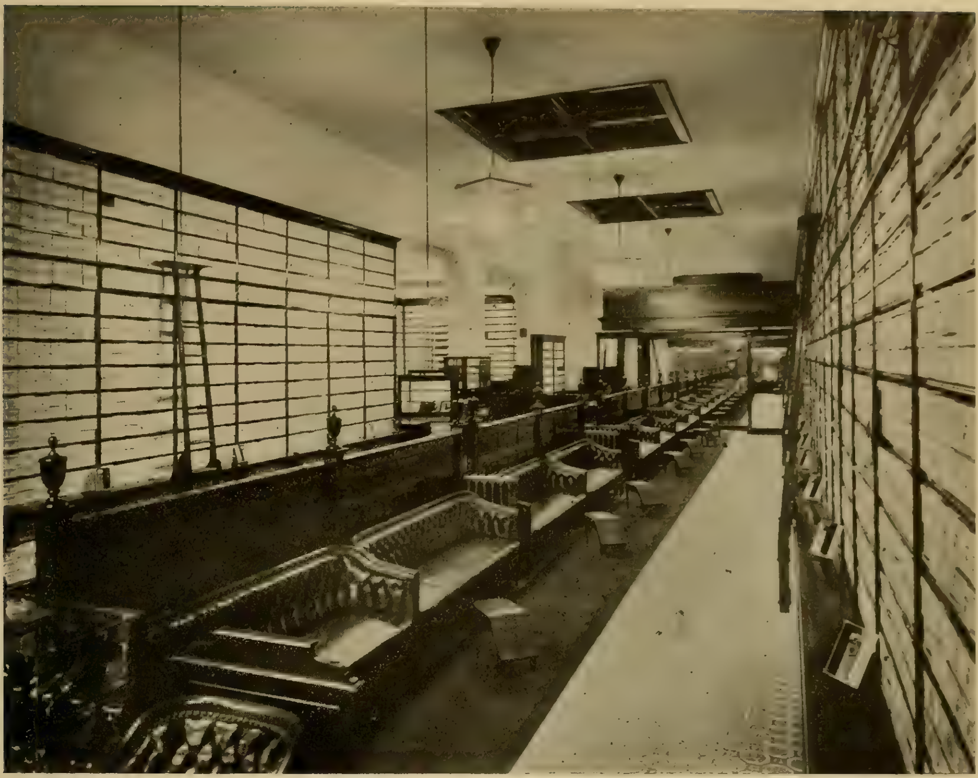


FIG. 3.—INTERIOR, REGAL SHOE STORE.

tungsten lamp in a vertical position in the center, and an asbestos disc reflector which, while answering its purpose admirably, also serves to keep dust and insects out of the hemisphere.

Our instructions were to use simple rather than elaborate fixtures, with attention to the final maintenance cost, rather than to the first cost, which is always the least. This has already been proven as the reduction in costs will be sufficient to duplicate this entire installation each six months and still leave a credit balance against the costs of current in the previous store, three doors east. The old store, while of slightly greater dimensions, was so arranged that the space for customers and sales had a capacity considerably below the present. Two additional settees are being used in the new store and they also have a greater stock shelf capacity. The illumination of the previous premises was marked rather by its absence than prominence. The two fixtures used in the ladies' department being particularly elaborate, and are stated to have cost $150 each, being very fine examples of filigree brass castings and fittings, and containing approximately 25-16 c.p. lamps each. The windows were outlined with 16 c.p. lamps in a horizontal position 10 in each corner, which, coming in line of vision between the observer and the goods, furnished a typical installation of a character, which while used very generally is about the best example of what not to do.

As will be seen in the photograph (Fig. 3), the six fixtures in the new store are plain squares of 1⅜ in. square 2′ x 2′, suspended on chain 12 ft. from the floor, with one light from each corner, using 80-c.p. 100-watt tungsten lamps, with Holophane reflectors.

The distribution is particularly good as shown on the photograph (Fig. 3) and by the values indicated on plan (Fig. 3) The horizontal intensities in foot-candles

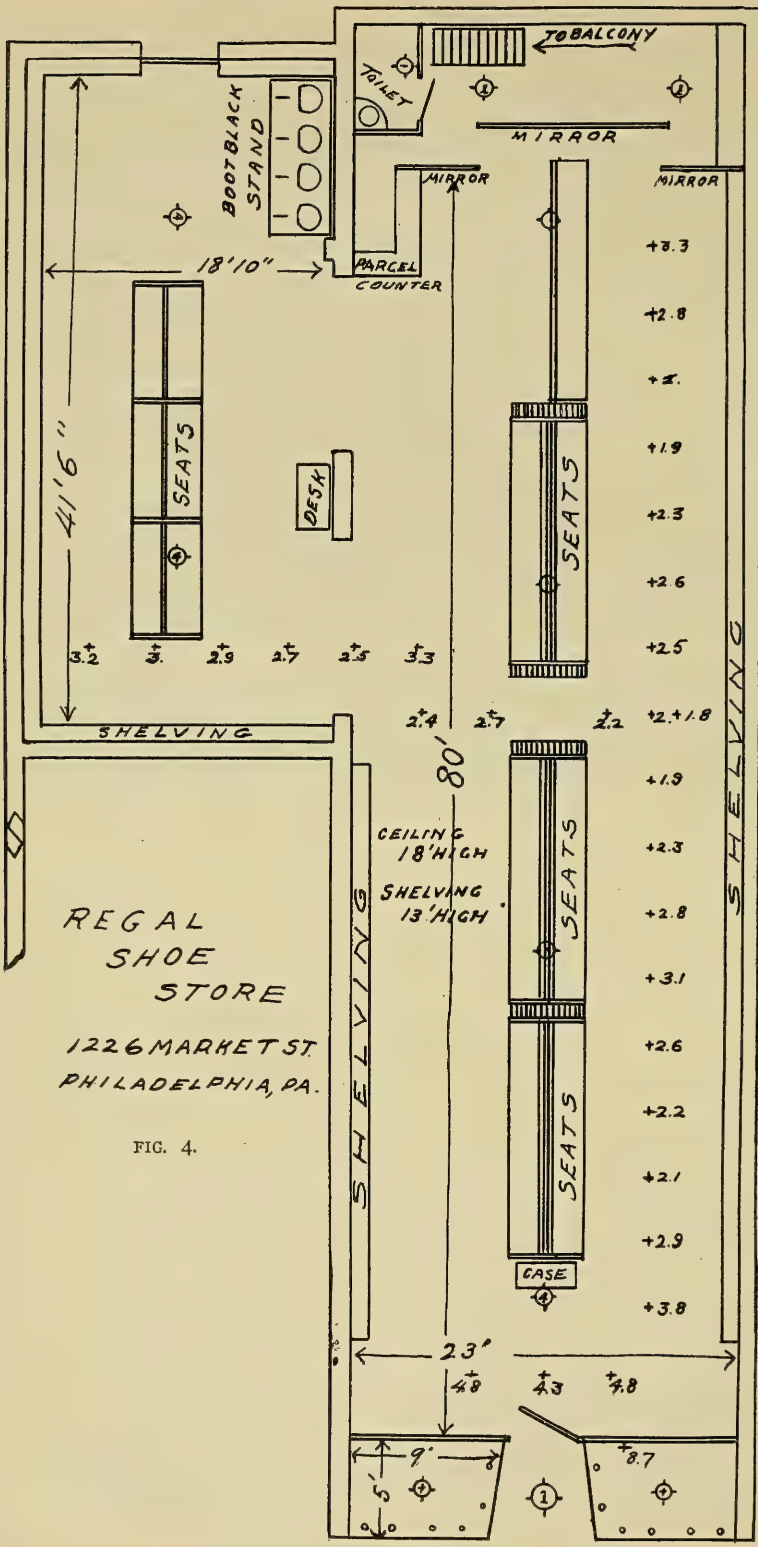
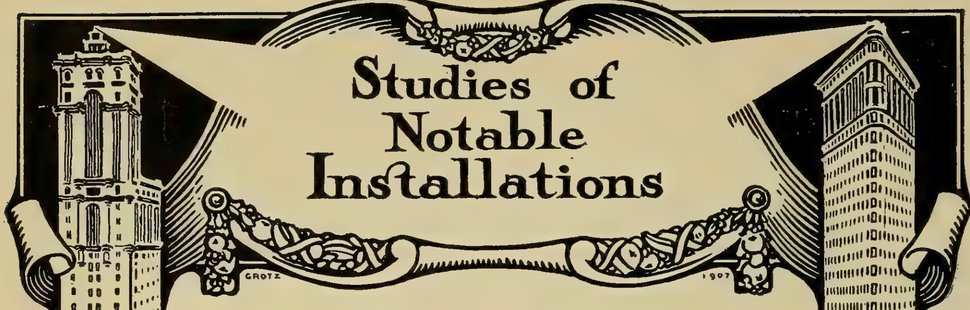

TO BALCONY
TOILET
MIRROR
MIRROR
MIRROR
BOOT BLACK STAND
PARCEL COUNTER
18'10"
41'6"
SEATS
DESK
SEATS
SEATS
SEATS
SHELVING
SHELVING
SHELVING
80'
CEILING 18' HIGH
SHELVING 13' HIGH
CASE
23'
9'
5'
REGAL SHOE STORE
1226 MARKET ST.
PHILADELPHIA, PA.

FIG. 4.

were taken with a Sharp-Millar illumination photometer on a plane the height of the stools on which shoes are fitted and observed by customers, with readings each 4′ down the store and across into the addition from west to east wall. The higher values in front can be attributed to the windows, as clear glass is used in the rear sash and the mirrors in the rear of the store are responsible for the addition there. At the time the calculations were made, neither of these points had been decided upon. The dimensions of the main store floor is 23′ x 80′, with the east addition 18′ 10″ x 41′ 6″, a total area of 2621.5 square feet with .91 watt per square foot and an average of 2.75 foot-candles effective on the plane, or .33 watts per foot-candle per square foot. At a glance this looks extremely low, but when considered on the basis of 1¼ watts per c.p. for tungsten lamps, is rather liberal. From a visual point of view this store has been passed on as being extremely satisfactory. The illumination intensity measurements as shown were taken when the lamps had passed 30 per cent. of their useful life, with new lamps the average would be somewhat higher, and these results developed a very interesting point, viz., the variation from 3 foot-candles to 2 between the fixtures, could not be observed even with the knowledge that it was there. On inspection, some difference, however, could be noticed at the front and rear where the higher values are shown. This increase is more desirable at the extreme ends than it would be in the center. By brightening up the ends and corners, which are so usually dark, we secure an appearance of high illumination intensity at a much lower wattage per square foot and cost per month than would otherwise be possible. The illumination on the box fronts is particularly good, and even to the top, a height of 13″, a salesman on the floor has no difficulty in deciphering the detail of the various labels. Requiring a minimum effort to run the eye over the box fronts, the maximum service can be secured, which considerably increases the output per salesman of this store.

The general color effect of the tungsten lamp is somewhat similar to arcs, and at first you rather have a sense of uneasiness until it is realized that you are looking for the anticipated variations due to carbon feed and wandering of the arc which are absent.

The photographs shown were taken at night, solely from the regular illumination in the store and windows. The negatives were not re-touched nor manipulated in any way. The prints, however, received an extra time exposure on the fixtures, as it was desired to outline these fixtures as much as possible, the entire purpose being to get photographs which would show the conditions as they appear to the eye, or as closely as is possible with present photographic processes. The amount of halation on a negative even when the general illumination is low, and the intrinsic brilliancy not visually high, is sufficient to densely cover a considerable area around the source of light. We desired to give the theoretical calculations from which these determinations were made, but realize that so many variables—candle-power, voltage, rating of lamps, exact position of holders, filament position in bulb, etc.—have to be considered, which at the present state of the tungsten lamp art are uncertain. This point must be passed over. It suffices to say that the data to hand were used and the usual extensive calculations made with results which were personally very satisfactory. Until the results of more research is available checking back from reliable illumination intensity measurements, many variables which now generally receive little consideration will become factors, which will enable the illuminating engineer to determine with a fine degree of exactness just what illumination he will have when the light is turned on.




# The "Terminal Building," New York.

By Charles J. Goldmark.

A good idea of the great saving with large increase in illumination which may be obtained by the use of the recently perfected tungsten lamp, with suitable reflector, may be obtained from an examination of the lighting system now being installed in the new office building at Forty-first Street and Park Avenue, New York. As this is perhaps the first installation of tungsten lamps installed in a building of this size, a description of the illuminating units and tests of the same may be of interest.

The building is approximately 100 x 100 feet, and 12 stories high. The lighting as originally planned by its owners contemplated the use of incandescent lamp clusters and porcelain shades, with four and three 16-c.p. carbon lamps, according to the size of the offices. When the matter was placed in the hands of the writer the outlets and wiring were installed. Gem lamps were first considered, but the results obtained with tungsten lamps were so far superior that they were finally chosen.

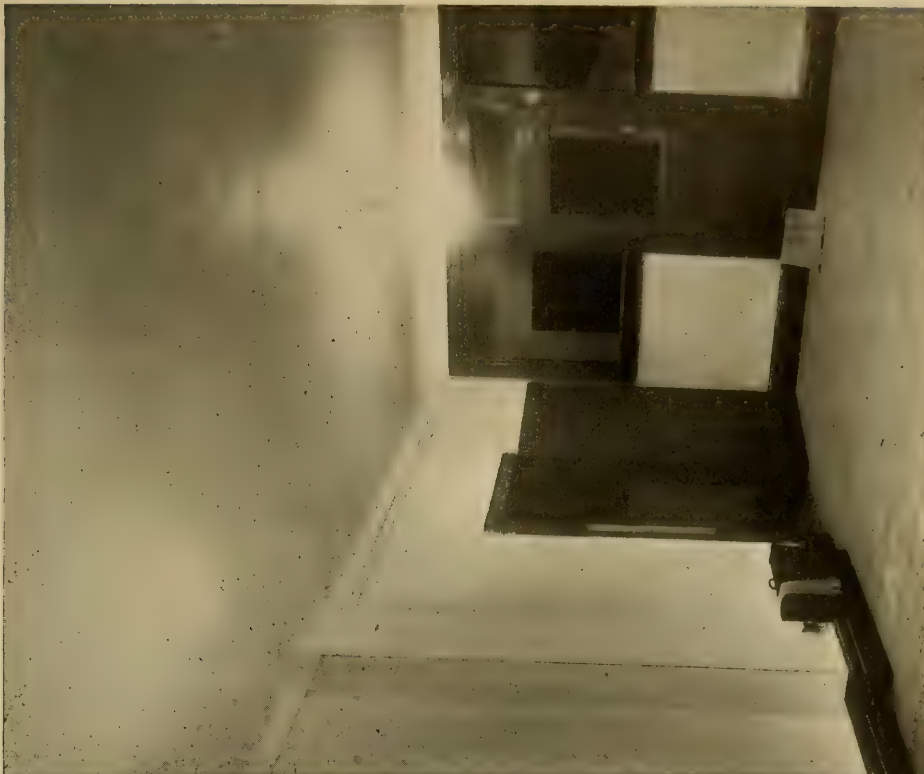
The unit adopted for nearly all the offices consists of a 4" stem fixture, a pull-socket, Holophane bowl reflector, with sand blasted interior, and General Electric 100-watt tungsten lamp, frosted on bottom. The lamps are guaranteed to have average useful life of 800 hours at a specific consumption of 1.25 watts per mean horizontal candle. On a basis of 3 cents per K.W. hour for current, each 100-watt unit will show a saving during its life of $1.35 over the 16-c.p. cluster which it displaces, or an estimated annual saving for the whole building of about $450.

In order to arrive at a perfectly fair and even comparison between the two systems of lighting, and to furnish an ocular proof of the advantages of the tungsten unit, two offices of exactly the same size were fitted up, one with two of the 100-watt units, and the other one with two four 16-c.p. carbon lamp clusters. Readings of illumination were taken with a Ryan Luximeter, furnished through the courtesy of the General Electric Co., in both offices; the results are shown in the curves and table. The actual saving in watts is 50 per cent., and the measured increase in illumination 60 per cent.

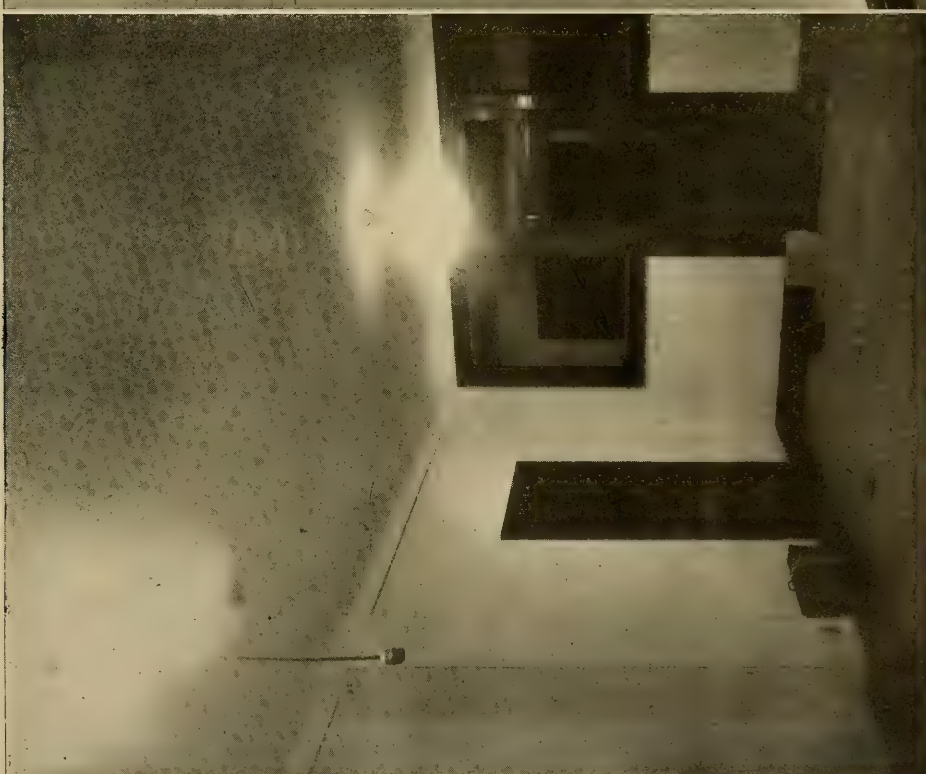
The photographs taken at the same time show clearly the difference in illumination. Both were taken with same exposure and printed together in same printing frame. The actual effect was even greater, as the office illuminated with the tungsten units appeared much brighter than the actual readings would indicate.

An interesting point in this connection is the very large increase in illumination as measured by the luximeter, compared to the illumination as calculated from the curves without any allowance for reflection, due to the very large amount of reflection from the walls, ceiling and floor.

The average foot-candles as calculated, without any allowance for reflection, is 1.92; the observed, 3.2 foot-candles; the



OFFICE LIGHTED WITH TUNGSTEN UNITS.



OFFICE LIGHTED WITH CLUSTERS.

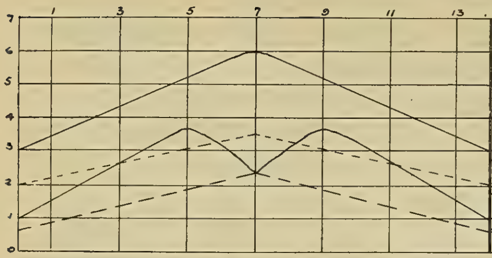


Diagram No. 1—Readings taken across room directly under lighting unit.

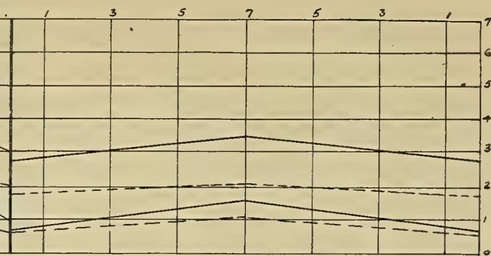


Diagram No. 2—Readings taken across room midway between lighting units.

Upper solid lines represent observed values with tungsten units.

Lower solid lines represent calculated values with tungsten unit with no allowance for reflection.

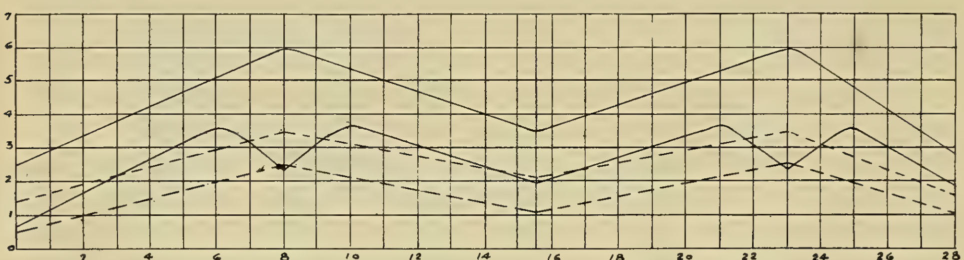


Diagram No. 3—Readings taken length-wise of room directly under lighting units.

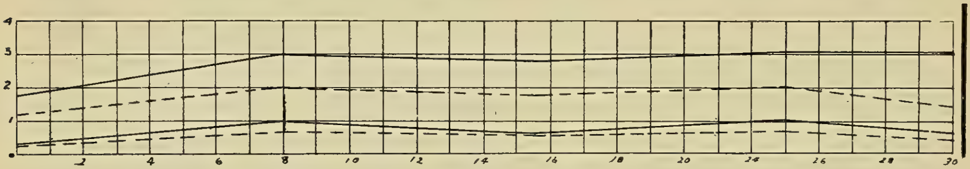


Diagram No. 4—Readings taken length-wise of room along wall about 8″ from same.

Upper dotted lines represent values observed with carbon lamp clusters.

Lower dotted lines represent calculated values with carbon lamp clusters with no allowance for reflection.

effective illumination factor is therefore 1.66.

It may also be of interest to state that a saving of approximately 50 per cent. was made on the fixtures by using a short stem fixture with canopy and Holophane reflector in place of four light cluster and porcelain shade.

Results of Illuminating Tests.

Two offices of same size, units placed 15′ apart, and 5′ from the ends of room, each office 28′ x 14′, white plastered walls and ceiling and new pine floor offices, empty. Two windows on one end, door and plastered partition 5 feet high on opposite end, no glass in door.

One door open on each side wall near plastered partition.

| | *Tungsten Lamps* | *Clusters* |
|---|---|---|
| Height of ceiling..... | 10′ 6″ | 10′ 6″ |
| Height of lamps...... | 9′ | 9′ |
| Height of test plane.. | 2′ 6″ | 2′ 6″ |
| Height of lamps...... (above test plane) | 6′ 6″ | 6′ 6″ |
| Total sq. ft. of floor.. | 400 | 400 |
| Total watts ......... | 200 | 400 |
| Number of lamps.... | 2 | 8 |
| Av'age watts per lamp | 100 | 50 |
| No. test stations..... | 15 | 15 |
| Watts per sq. ft..... | .5 | 1.0 |
| Sq. ft. per watt...... | 2.00 | 1.00 |
| Ill. mean ft. candles.. | 3.2 | 1.92 |
| Ft. candles per watt per sq. ft.......... | 6.4 | 1.92 |
| Watts per sq. ft. per candle ........... | .15 | .52 |

# Theory and Technology

## A Calculator for the Use of Illuminating Engineers

By Norman Macbeth.

The mathematical work involved in the various calculations which at one time or another have to be made by illuminating engineers require either long and tedious multiplications and divisions, with the attendant liability of errors, or the use of voluminous tables, with a like liability to error in transcribing.

The purpose of the calculator here described is to apply the familiar principle of the slide rule to the solution of the various formulæ which occur in the mathematical work of illuminating engineering. By this means all arithmetical computations are avoided, with the single exception of determining the position of the decimal point, which will afford very little difficulty, even to the inexperienced.

The calculator consists of three parts; namely, two concentric celluloid discs having circular scales printed upon them, and turning upon their common center, and a runner of transparent celluloid, also turning about the center, and having on its surface a fine radial line. The only knowledge necessary to make all the possible computations that may be required is the ability to read scales, and an understanding of the method of setting the scales for the different computations required. This knowledge can be attained with a reasonable amount of practice, entirely independent of any previous knowledge of higher mathematics.

The entire mathematical basis of illuminating engineering is expressed by the following two equations:

$$(1)\quad I_n = \frac{cp}{d^2} \qquad (2)\quad Ih = \frac{cp}{h^2}\cos^3 a$$

Equation 1 embodies the familiar "law of inverse squares," and is the formula of determining the intensity of illumination on a surface perpendicular to the rays of light. In this equation $I_n$ is the normal or perpendicular illumination; cp is the intensity of the rays in candle power that strike the given surface; and d is the distance of the surface from the light-source. There being three different quantities in this equation, if any two of them be given, the third can be found. There are, therefore, three possible problems:

A. Given the candle power and distance, to find the intensity.

B. Given the intensity and candle power, to find the distance.

C. Given the intensity and distance, to find the candle power.

Equation 2 gives the mathematical relation between the intensity of illumination on a horizontal (or vertical) surface at a given distance from a point directly below the light-source, and the candle-power intensity of the rays at the angle at which they strike the given surface. In this formula there are four different quantities, three of which must be known in order to determine the fourth one. The several problems arising from this equation are the following:

Given the height (h) of the light-source above the surface, the angle (a) which the ray striking the given surface makes

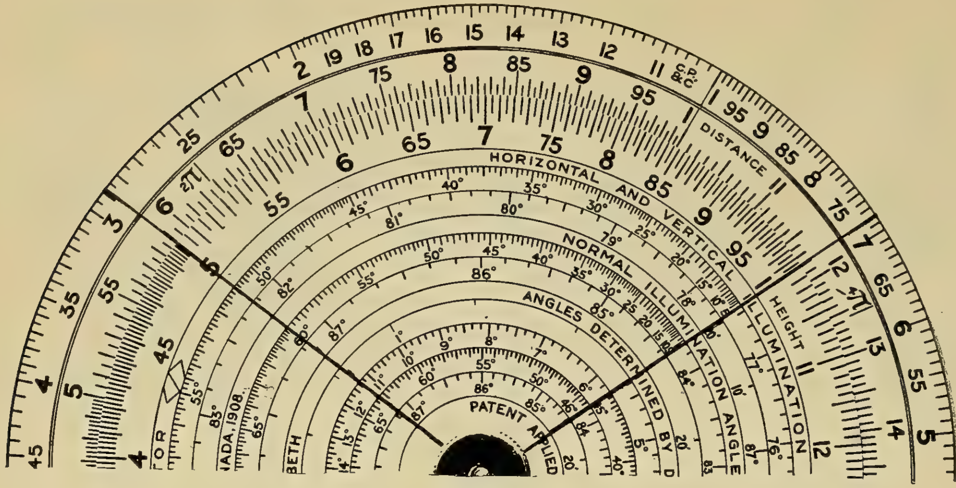



FIG. I.

with the perpendicular, the candle-power intensity( cp) of the light-source at this angle; to find the intensity of illumination.

Given the intensity of illumination, the height, and the angle, to find the candle-power.

Given the intensity of illumination, the candle power, and the angle, to find the height.

Given the intensity of illumination, the candle power, and the height, to find the angle.

There are two preliminary calculations that may also be required in order to solve problems under the general equation; namely:

Given the height and the angle, to find the distance.

Given the angle and the distance, to find the height.

Beside these fundamental calculations, all other calculations that may be necessary, such as reducing from one form of unit to another, including all the units that have been proposed for the measurement of illumination, such as mean spherical candle-power, lumens, etc., and ordinary division and multiplication, can be made by the use of the calculator.

The arrangement of the several scales upon the two discs, is shown in Fig. I. The larger disc contains two scales; the scale on the outer circle is used for reading both intensity of light in candle-power, and intensity of illumination in foot-candles. The inner, or smaller, scale is used to determine distance from the foot of the perpendicular drawn through the given light-source. The smaller disc contains 9 circular scales; beginning with the outer, or larger circle, the scale marked "height" gives the heights of the light-sources above the given plane. The next two circles form a single scale, which is marked "horizontal and vertical illumination angles," and is used in problems in which it is required to determine either the horizontal or vertical intensity of illumination from rays striking at a given angle, or for determining the angle of the incident rays when the height of the light-source, and the distance to the point on which it is desired to determine the illumination from the vertical, are given. For measurements within the most useful angles the scale reads in degress and 20 minute divisions, which is far within the limits of accuracy ordinarily secured for photometric work.

The next two circles toward the center form a single scale, marked "normal illumination angles," which is used in problems requiring determination of the intensity of normal illumination when the candle-power and angle is given, or when the intensity of illumination and height are given to read c.p. at all angles. The remaining four circles constitute a single scale for determining the

angle when the height and distance are given, or the distance corresponding to any given height when the angle is given.

While the scales have been designed particularly for the purposes mentioned, they can be used for the solution of a great number of other problems, which are fully explained in the book of instructions accompanying the calculator.

The rapidity and ease with which calculations can be made will be best understood by the solution of a few typical problems. Let us suppose that we wish to determine the horizontal intensity of illumination from the ordinary 16 c.p. lamp, placed at a height of 5 feet above the surface, and over a space of 10 feet radius from the point directly underneath the lamp.

We must have for the solution of this problem the candle-power at various angles, which is given by the ordinary polar distribution curve. Beginning with the position directly under the lamp, we read the candle-power from the distribution curve, which is 7.2. We then proceed as follows:

Set the hair line on the transparent celluloid "runner" directly over the mark representing 7.2 on the outermost, or candle-power scale on the large disc.

Hold the runner and large disc together and turn the smaller disc bringing zero under hair line.

Hold the two discs together, and bring the runner to 5, the given height, on H, or height scale, of the smaller disc.

The resultant intensity of illumination is then read on the candle-power scale under the line on the runner. The final setting is shown in Fig. 1.

In this case the line falls on the scale between the marks indicating 285 and 29 Estimating with the eye between these two values, we get 288. As before mentioned, however, the scales do not give the position of the decimal point, which must be determined by the general conditions of the problem. In this particular case, it is apparent that there will be less than one foot candle illumination underneath the lamp, $\frac{7.2}{5^2}$ and the position of the decimal point therefore belongs before the first figure: therefore .288 foot-candles is the result required.

Let us now determine the horizontal illumination at the farthest point on the assumed plane, namely, at 10 feet distance from the point directly underneath the lamp. In order to determine the candle-power value from the distribution curve we must first know the angle which the ray will make at the given height and distance. The operation is as follows:

Set 5 on H scale over 10 on D scale, bring runner to 1 on D scale, and under runner in the second smaller circle read 63° 20′ or 63 1/3 deg.

As explained before, the figures on the scales may be given any value produced by decimal multiplication or division; for example, the 1 may be used for 1, 10, 100, etc., or .1, .01, .001, etc.)

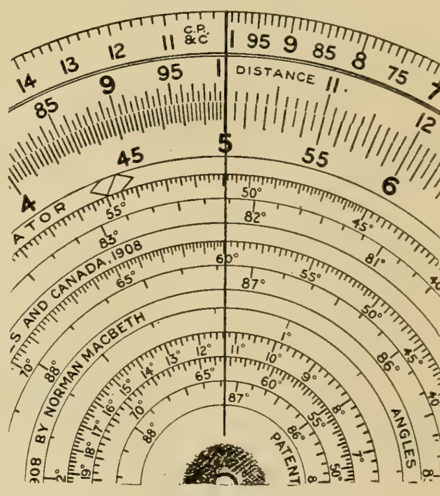



FIG. 2.

Scales for determining angles from heights and distances are arranged in four circles as lettered on the runner N. O. P. and Q.

N circle covers angles for all distances from 1/100 times the height to 1/10 height.

O circle for 1/10 H to 1 H.

P circle for angles from 1 H to 10 times H.

Q circle for angles 10 times height to 100 H.

This would bring all angles from a light-source 10 feet high between 1/10 foot distance and 1 foot from the perpen-

dicular into N circle, between 1 foot and 10 feet O circle; 10 feet to 100 feet P circle, and 100 feet to 1000 feet Q circle.

Referring now to the distribution curve, we find the candle-power at 63 degrees is 15. We now have the angle, candle-power, height, and distance determined, and the required horizontal illumination will be determined by exactly the same procedure as in the above example: thus,

Set the runner at 15 on the candle-power scale;

Hold the runner and other disc together and turn the inner disc to bring 63° 20′, on the scale marked "horizontal and vertical illumination angles" under the line.

Hold the two discs, and bring the runner to 5 on the height scale. Under runner on outer scale read 542 (five four two). (See Fig. 3.)

The only question now is the significance of this 542. To determine the decimal point with both discs as set, refer back to zero angle, from which we note that the equivalent candle-power at 0°, to 15 candle-power at 63° 20′ is 1.35; the decimal point may then be readily determined by $cp/h^2$ or 1.35/25, to equal .05 roughly, or as read fully under the runner at 5 ft. height, .0542.

It may be necessary in the beginning to check by approximate calculations the decimal values, but after a number of

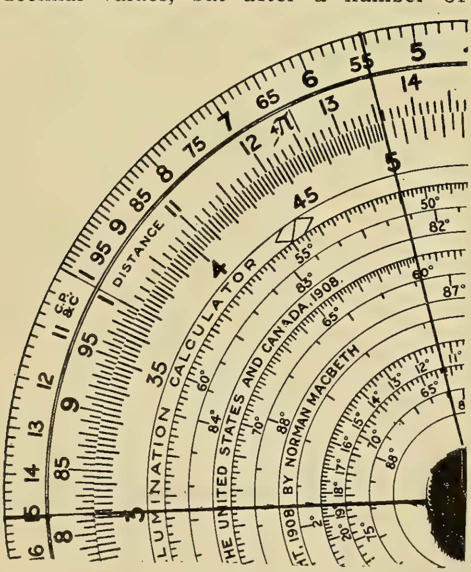



FIG. 3.

problems have been solved, the position of the decimal point will generally be at once apparent.

The intensity at any distance from the vertical may be determined, and the curve of horizontal intensity plotted from the results. It will be seen that the determination of the horizontal illumination, for any given distance and height with angle and candle-power unknown involves 5 different steps, viz.:

1. Setting height on inner disc on distance on outer disc.

2. Bringing runner to 1 on outer disc and reading angle.

3. Setting runner on outer disc on candle-power.

4. Setting angle on inner disc to runner.

5. Reading intensity on outer scale opposite value on height scale.

The solution of all the possible variations of this general problem can be obtained by the same number of settings. With known candle-power and angle, all foot-candle intensities may be read for all heights with one setting only.

The rapidity and accuracy with which the results are obtained, together with the fact that no extensive mathematical knowledge is required, will render the laying out of lighting installations on a basis of intensity of illumination a very simple matter. One of the best methods to follow in such a case is to lay out a distribution curve which will give the required illumination with the light-source at the proper height. This can be very readily done by reading the intensities from the calculator at a sufficient number of angles, necessary to produce the requisite illumination, on whatever plans may be assumed, and then plotting a polar distribution curve from the values thus obtained. Such a curve may then be compared with the polar distribution curves of the various available light units and the one coming the nearest to the theoretical curve thereby be selected.

With the long and tedious labor of numerical calculations removed, there is no reason why the laying out of even the simplest installations should not be at least checked up by a mathematical determination of the illumination.

# A Convenient Method of Drawing the Rousseau Diagram

By W. S. Kilmer.

In order to draw a Rousseau diagram on plain paper, it is necessary first to draw a semi-circle; divide this up by radical lines at the various angles at which the measurements of intensity have been made, draw parallel lines from the points where these radical lines meet the circumference of the semi-circle. The resulting diagram will be as shown by the dotted lines in Fig. 1. The drawing of this diagram necessitates the use of a draughting board, compass, protractor, and T square or triangles. All of this work can be entirely dispensed with by the use of cross section paper which can be obtained at a trifling cost from any dealer in drawing materials. The most convenient form to use is a sheet about the size of a regular legal cap paper, divided into half-inches sub-divided into tenths, the cross sections covering a space 7½ x 10 inches. Taking the longer side of the cross section as the base line, BB′, consider the semi-circle to be drawn from the center, with a radius of 10. Taking this radius as 1, the lines of the paper divide it into tenths and hundredths, which may be marked along the edge, beginning at the center. The distances of the horizontal lines from the center line of the diagram represent the cosines of the angles, described by the radii from which they are drawn, and may therefore be obtained from a table of natural sines and cosines. For convenience the values to two places, which is sufficient for the present purpose, are given below:

| Angle. | Cosine. | Angle. | Cosine. |
|---|---|---|---|
| 0 | 1.00 | 50 | .62 |
| 5 | .99 | 55 | .57 |
| 10 | .98 | 60 | .50 |
| 15 | .96 | 65 | .42 |
| 20 | .93 | 70 | .34 |
| 25 | .90 | 75 | .25 |
| 30 | .86 | 80 | .17 |
| 35 | .81 | 85 | .08 |
| 40 | .76 | 90 | .00 |
| 45 | .70 | | |

The positions of the horizontal lines for a polar diagram using 15° angles can be at once determined by simply reading their corresponding cosine values, taken from the table, on the scale along the base line. These have been indicated by solid lines in the figure, which of course would coincide with the dotted lines, if extended. The actual drawing of the semi-circle, radii, and horizontal lines, is therefore quite unnecessary; the rulings of the paper can be readily utilized for the purpose.

Having thus located the horizontal lines, the candle-power values can be plotted with equal readiness by using the vertical rulings of the paper as a scale.

A single example will make the whole matter clear. For this purpose let us take the case of the ordinary 16 c.p. lamp. The intensities at the various angles as given by the Bureau of Standards are as follows:

| Lower Hemisphere. Angle. | C.P. | Upper Hemisphere. Angle. | C.P. |
|---|---|---|---|
| 0 | 7.2 | 0 | 0. |
| 15 | 8.1 | 15 | 2.0 |
| 30 | 10.2 | 30 | 8.5 |
| 45 | 12.8 | 45 | 12.2 |
| 60 | 14.6 | 60 | 14.7 |
| 75 | 15.7 | 75 | 15.8 |
| 90 | 16. | 90 | 16. |

The most convenient scale for plotting these values will be the one given at the bottom of the diagram. The several candle-power values then fall at the points indicated by the O's, through which the required curve is drawn.

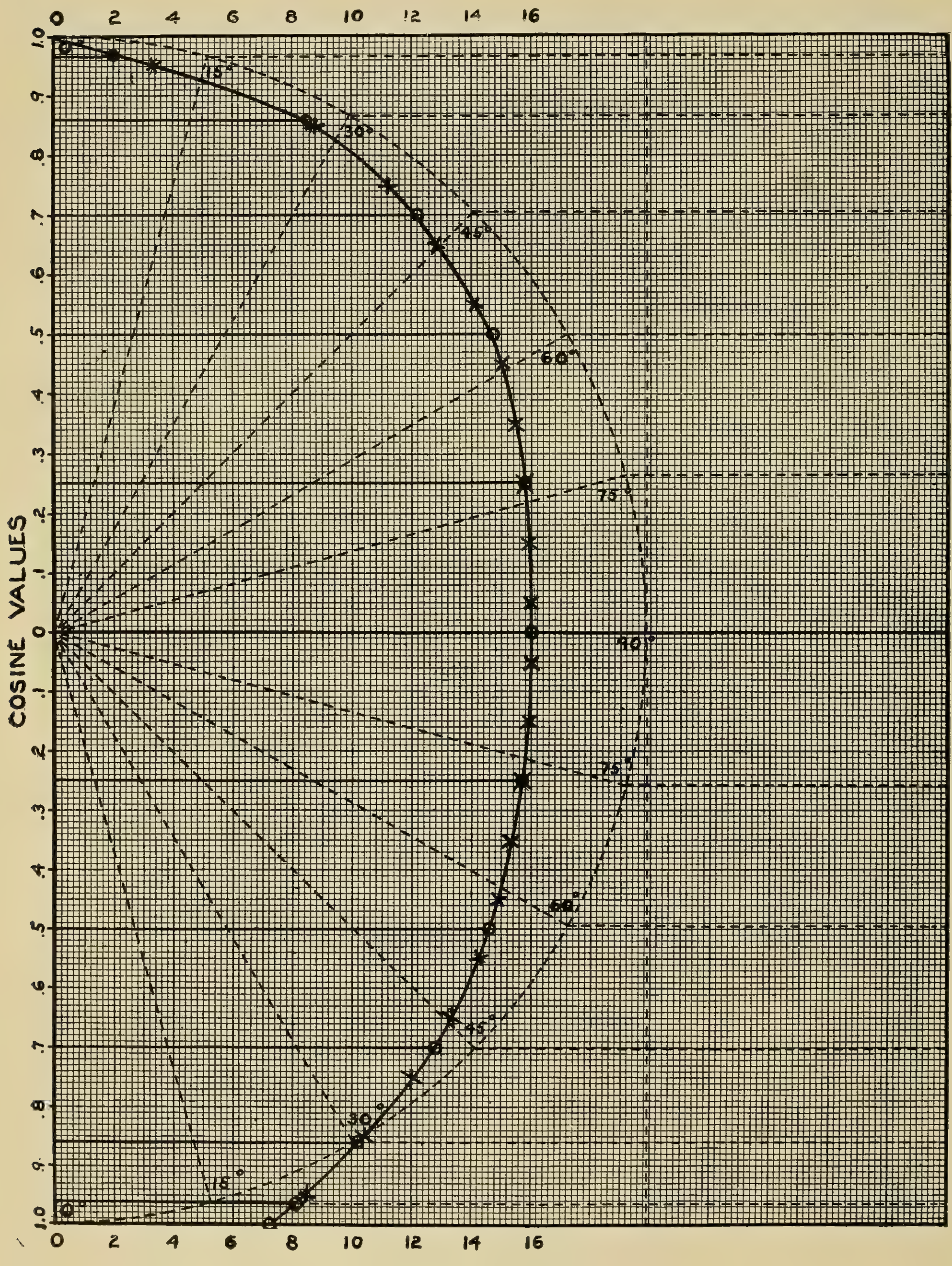
| *Lower Hemisphere.* | *Upper Hemisphere.* |
|---|---|
| 8.4 | 15.9 |
| 10.4 | 15.8 |
| 12.1 | 15.6 |
| 13.3 | 15.4 |
| 14.2 | 15.0 |
| 14.9 | 14.3 |
| 15.4 | 13.0 |
| 15.6 | 11.4 |
| 15.8 | 8.6 |
| 15.9 | 3.0 |

136.0 ÷ 10 = 13.6 128.0 ÷ 10 = 12.8

13.6 + 12.8 = 26.4. 26.4 ÷ 2 = 13.2 = M.S.C.P.

To obtain the mean spherical c.p., the curve may most conveniently be divided into ten zones to each hemisphere, each zone being one-half inch in height. The mean candle-power value for each zone will read off at the point where the quarter inch line, which is the center of the zone—crosses the curve. These points are indicated by X's on the diagram and their values are read from the scale at the bottom, are as given in the preceeding table.

The sum of these values, divided by the number of zones—ten for each hemisphere—gives the mean hemispherical or spherical candle-power required.

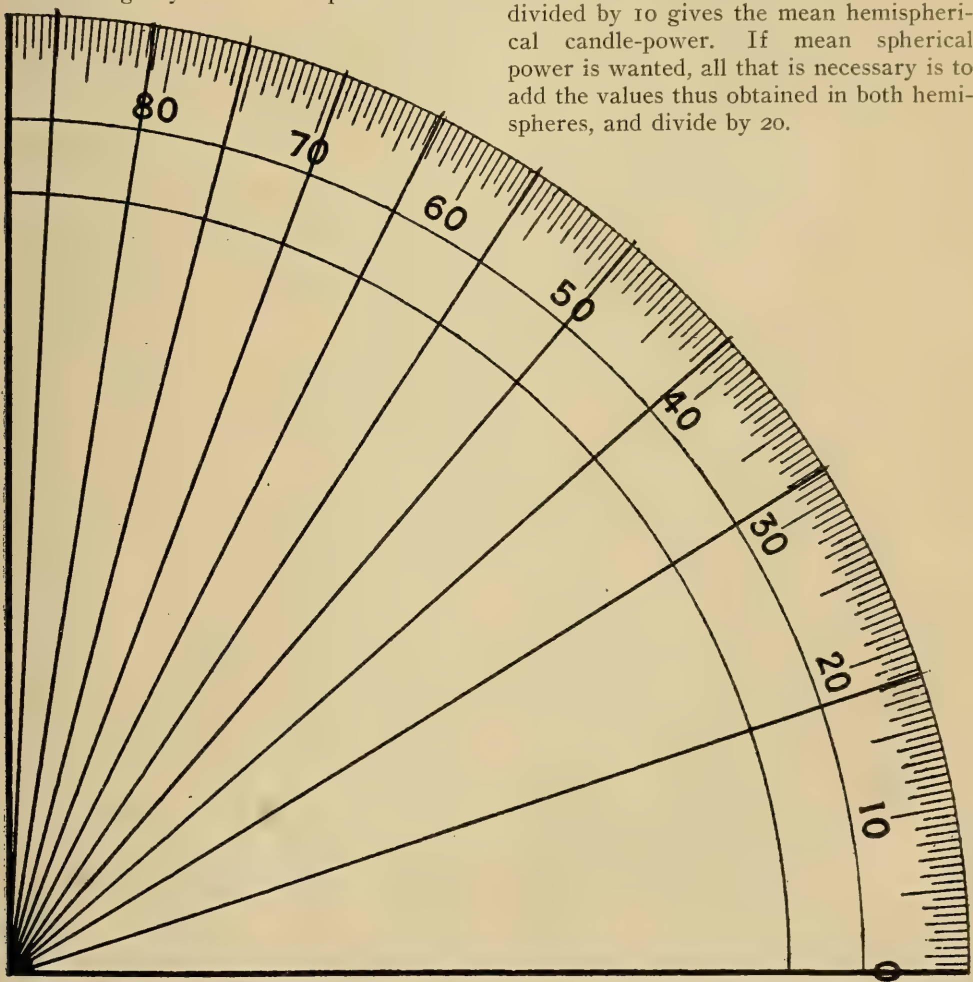


## A Method of Determining Mean Spherical Candle-Power Without the Use of the Rousseau Diagram

By Norman Macbeth.

The principal use of the Rousseau diagram is for the purpose of determining mean-spherical, or hemispherical candle-power, its graphic significance having comparatively little value. In order to obtain these quantities, the area of the curve is divided up into a certain number of zones, whose area are separately computed; the sum of these areas, divided by their number, gives the result required.

In the method described by Mr. Kilmer, the readings by which the spherical candle-power is determined from the curve, are taken on lines running through the centers of the ten different zones into which each hemisphere is divided. If we work this method backwards, *i.e.*, determine the angles on the polar diagram corresponding to the cosine values; on which these lines are drawn, and read the candle-power intensities at these angles, it is then only necessary to add these values and divide the sum by ten, to arrive at the spherical candle-power. In order to use the method, the angles may be drawn on transparent celluloid, or tracing cloth, of convenient size to place over the polar curves which are to be read. The candle-power values at each of these angles can then be read direct from the polar distribution curve. The sum of these values divided by 10 gives the mean hemispherical candle-power. If mean spherical power is wanted, all that is necessary is to add the values thus obtained in both hemispheres, and divide by 20.




## A Year's Progress in Illuminating Engineering

The year intervening between March 1, 1906, to March 1, 1907, has been an eventful one in the commercial history of the country. From the highest pinnacle of material prosperity that we had ever reached we took a sudden plunge into the abyss of financial panic, and are but just now beginning to recover sufficiently from the shock to gather our scattered senses in a dazed sort of way, and are trying to find out just what happened, to discover the extent and location of our injuries, and to collect our thoughts and concentrate them on some coherent plan for recovery. All agree on the one fact that we were constitutionally sound, and that therefore a complete and reasonably speedy recovery may be confidently expected. The present time is one of commercial convalescence. Business has been undergoing a period of suspended animation, but is again showing most unmistakable signs of returning life.

Notwithstanding the suddenness and extent of this shock, the year has been marked by a large measure of progress in the field of illuminating engineering. While some phases of this progress can be more or less accurately indicated by figures, there are other phases which wholly elude this mathematical form of expression. To those who have kept in close touch with all the various interests and elements connected with this new science, there are the most unmistakable evidences of both a wider and deeper interest in the subject than existed a year ago. Among the many indications of this increasing interest may be mentioned the vastly greater amount of literature on the subject appearing in both the technical and popular press throughout the world. It is safe to say that in point of mere amount, such literature has at least doubled during the year.

The Illuminating Engineering Society has continually increased its membership and added measurably to the general strength and importance of the papers and discussions presented before its various sections.

The number of professional illuminating engineers has largely increased—both those connected with commercial enterprises and those who are practicing independently.

The profession has been recognized by special courses of instruction in some of the technical schools, and more extended courses and regular text-books on the subject are either in preparation or contemplation.

The United States Government has employed the services of a consulting illuminating engineer in connection with the extensive and magnificent Congressional office buildings at Washington and the new Army buildings at West Point.

Electric lighting companies have very generally recognized the science by either assigning some one of their present employes to the work of making a special study of the subject, or have employed those already proficient in the science. More recently the larger and more progressive gas companies have also taken up the matter seriously in connection with their commercial departments.

On the whole the profession of illuminating engineering may be said to be thor-

oughly and firmly established; so that he who would today question the right of the illuminating engineer to a position among the other engineering professions, would be at once set down as hopelessly and inexcusably behind the times.

The material advancement of the science has been equally great. In the field of electric lighting, the high efficiency incandescent lamp, which was represented only by the Tantalum lamp a year ago, with the promise of still more efficient forms in the near future, is now represented by the Tungsten filament lamp, which has already become a factor of commercial importance in the lamp industry, with the sure promise of an exceedingly rapid increase in importance. While it is thus well out of the experimental stage, there is still considerable room for improvement in the way of mechanical stability; but recent progress along this line gives every reason to assume that this defect will be largely removed before another year has passed around.

In the field of arc lighting the luminous or metallic arc has made substantial progress. New forms have been brought out and new manufacturers have come into the field. The prophesy of a year ago that this form was to be the successor of the enclosed carbon arc for street lighting purposes seems to be substantiated by its present position. Progress in this line is sure to be rapid in the coming year. The flaming arc lamp, which, on its first appearance in this country was thought to find a field only for spectacular and advertising purposes, has demonstrated that it has a place in commercial lighting which it is likely to hold for some time to come. For the illumination of large open spaces, such as docks and railway yards, and for the illumination of large mills and works, it is without a peer among light-sources at the present time. On the other hand, its use for advertising purposes has been somewhat weakened by the public becoming familiar with it, its original value for this purpose being dependent, as in all other similar cases, to a considerable extent upon its novelty.

In the field of gas illumination the inverted burner, which was of more or less doubtful utility on its first introduction into this country, owing to certain physical conditions in regard to gas distribution and supply, has been improved and adapted to these conditions to such an extent that it has come to be the most important factor in determining the future of gas lighting in this country. Along with this improved burner has also come a considerable progress in the practical means of lighting and extinguishing gas from a distance, comparable with the turning on and off of electric lights by switches. The inverted burner has the advantage of greater artistic possibilities, greater stability of mantles, and better natural distribution of light, and a far less tendency to blacken and disfigure ceiling decorations. The advent of the inverted burner is bound to lead to a revolution in the construction of cluster gas lights which have been generally termed "gas arcs." While the problem of the inverted gas arc has not been thoroughly solved as yet, there are the best of reasons for predicting its early advent as a practical commercial light-source. The production of a small, convenient, and cheap incandescent gas burner is also one of the certainties of the near future. The use of high pressure gas and artificially intensified burners, which are established facts in England and Europe, have made practically no progress as yet in this country, and it remains to be seen what influence these are to exert on the general lighting situation.

Lighting by vacuum and vapor tubes has held its own, but can hardly be said to have made material progress within the year.

In the manufacture of fixtures and lighting accessories there are evidences of a tendency to break away from the traditional forms which have held sway for so long, and to base their construction upon illuminating engineering principles. Several manufacturers have given special attention to the production of new designs of fixtures along these lines.

Not the least among the evidences of progress in the practical field is the appearance of the Macbeth calculator, by which every possible mathematical calculation in the laying out of lighting installations can be quickly and accurately made

without arithmetical computations. An account of this valuable apparatus appears in another part of this issue.

Along the same general line should be mentioned also the appearance of the Miller-Sharp photometer, which puts the measurement of illumination more nearly upon a basis of exact science than has heretofore been possible, and we have reason to believe that at least one other form of illuminometer will soon be obtainable by the public.

The sale of illumination based upon the measurement of light has also received a great impetus during the year in consequence of the report of the special committee appointed by the National Electric Light Association to investigate this subject, and also upon the wide discussion of the topic in the technical press.

On the whole the progress in the field of illuminating engineering during the year has been most gratifying, and should amply satisfy the expectations of even the most enthusiastic in the profession; and every indication at present points to equally great progress during the coming year.

## Constructive Illuminating Engineering

Engineering as a general term might be defined as "applied science." If we substitute in this expression the generally accepted definition of science as "classified knowledge," and qualify the term "engineering" by the word "illuminating," we arrive at the statement that illuminating engineering is the application of a classified knowledge of artificial light. A further analysis of this generalization brings out the fact that the first necessity is knowledge of the subject; the second, a classification of this knowledge, based upon the relation of its different elements, into a systematic whole; and lastly, the application of this system to the actual problems and conditions that arise. As is always true in the early stages of development of any new branch of science, the sources of knowledge of illuminating engineering at the present time are widely scattered. The foundations are to be found in works of mathematics, physics, and physiology. From this common foundation illuminating engineering begins to differentiate itself in the general subject of physics, requiring the least amount of pure mechanics, and the largest amount of the subject commonly known as optics, involving the nature, laws and measurement of light. The collateral branches of electricity and chemistry are highly useful subsidiaries. Perhaps the most characteristic distinction of this particular branch of engineering is in its requirement of a considerable degree of knowledge of physiological optics. In no other branch of applied science is there such a union of physics with physiology and psychology. The classification of knowledge is always a variable process, the divisions depending entirely upon the purpose for which the classification is wanted. Thus, from the standpoint of pure science, illuminating engineering knowledge might be divided into mathematics, physics, psychology, and esthetics; but such classification is like the division of a dinner into courses, which serves its temporary purpose, but has no bearing upon the assimilation of the various elements of food into the bodily organism. The theoretical knowledge, which is just as essential to success as are the various articles of food to the body, becomes actually serviceable and convertible into practical results when assimilated by the process of experience and judgment. Constant use makes knowledge a second nature, which is capable of acting apparently by intuition. The true mechanic will generally draw a better machine designed purely from his inner consciousness than can the best of theorists by the aid of their rules and calculations. But such ability does not exist ready made, and unless there has been sound theoretical training at the foundation, never reaches its highest state of perfection, even with the aid of the greatest natural ability. As Dr. Humphries pointed out in a recent address, it is idle to discuss which is the more important theory *or* practice. Theory *and* practice is the essential to success. Since theory of necessity comes first, it naturally follows that, illuminating engineering being of recent origin, there should be more theoretical than practical illuminating engineers in the field at the outset;

and since there is no established qualification, it is not surprising that the title is sometimes assumed, in perfectly good faith no doubt, by those whose theoretical qualifications are doubtful and their practical experience wholly inadequate to the achievement of valuable results. This weakness, however, will be corrected as knowledge of the subject becomes better organized and the results of practice more numerous.

While it is not absolutely essential that an engineer personally construct, or even supervise the construction of works which he has specified, there is no doubt that such a course would prove valuable in many cases. There is undoubtedly a wide and unoccupied field open at the present time for competent and conscientious constructing illuminating engineers. That the majority of lighting installations are both defective in results and inefficient in methods, there is no question; and that the reconstruction of such systems on good engineering principles would bring about economies of operation and improvement of results that on any fair basis of division would yield a handsome remuneration to the engineer, is equally certain. There are two conditions, however, that are absolutely essential to the success of such work; first, a thorough and practical knowledge of the entire subject; and, second, a scrupulous and rigid adherence to professional ethics. The field has already attracted the attention of that class of unscrupulous adventurers who are always watching for an opportunity to take advantage of public ignorance on any particular subject.

"Seeing is believing," is a generally accepted truth; but there is nothing more easily tricked than the eye, as is evidenced by the perennial existence of the "shell game," and other similar delusive devices. The offer to produce the same illumination for a far smaller amount on a basis of dividing the saving with the magician who performs the trick, appeals to many persons who have at least the average shrewdness in ordinary business; and considerable sums of money have been gathered in by various schemes of this kind. So long as the man who pays the bills is willing to divide, it is "easy money" for the schemer; and when he at last awakens to the fact that he is being bled, the actual cost of the changes has usually been paid for several times over, and by the form of contract entered into, the goods come back to the owner who installed them. The scheme is therefore a "sure thing" for the schemer. This sort of proposition, however, has absolutely no place in professional or commercial ethics. The engineer who can tell you how to secure higher efficiency of any kind is entitled to a reasonable fee for his knowledge; but having imparted the information and demonstrated his proposition, his usefulness in that particular case ends. Further economies depend no longer upon his knowledge of the subject. On the other hand, the value of the services of the engineer are measured by the value of the results obtained, rather than upon the actual cost of whatever material or labor may be necessary in the work. The illuminating engineer who, by his knowledge, skill and experience, can so remodel a lighting installation as to reduce the maintenance charges 50 per cent, is justly entitled to compensation for such knowledge entirely apart from any consideration of the amount of money involved in the changes. An illuminating installation put in simply as an electric contract offers every temptation for extravagance in the use of electrical materials and fittings, and excessive labor cost. If such an installation is by gas instead of by electricity, the same general rule applies; and if the fixture manufacturer has the contract, there is the temptation to trim on either the wiring or piping, and load expenses onto the fixtures. As a legitimate problem in constructive illuminating engineering, however, paid for on the basis of results obtained in connection with economies in maintenance, business and ethics work together to reduce both the original and maintenance cost to the lowest possible amount consistent with the required results.

The field of constructive illuminating engineering offers special inducements to electrical contractors, gas fitters, and fixture manufacturers. All that is necessary for success is to faithfully apply the two necessary elements mentioned; and while

results might be a little slow at first, competency and fair dealing would soon secure both public confidence and patronage. The electrical contractor is in business for the profits to be made; if these profits can be made from his superior knowledge of the subject of light, and skill and honesty in applying this knowledge, they would be quite as acceptable as if made by the mere buying and selling of goods; in fact, they would be more satisfactory, since they require less cash capital. And the same holds true in the case of the pipe-fitter and fixture dealer or manufacturer. The fixture dealer must now look for profits chiefly from the amount of metal in the shape of alleged ornamentation that he can get his client to accept. This necessitates the investment of capital in both labor and materials. It would be far more satisfactory to both manufacturer and customer if the legitimate profit depended upon the utility and economy of the results, rather than upon the mere quantity of metal and glass hung up. Instead of seeking profits by the loading up of fixtures with useless decorations, it would be far more satisfactory to produce fixtures that should be correct from the engineering standpoint, and individually works of art, rather than mere stamp-and-die copies of stock designs. The artist is not paid for his work by the square foot of canvas covered, but by the intrinsic merit resulting from his own individuality; and the public would be just as willing to pay the fixture manufacturer on the same basis, if they could receive correspondingly meritorious work. None but the incompetent and the dishonest have any occasion to fear that sound illuminating engineering will encroach upon their business profits; on the contrary, to the progressive, the intelligent and the right minded, it offers the most glittering inducements for business success.

## The Rating of Lamps

A further word on this topic, which may seem to the reader to be already worn threadbare, is suggested by the adaption of the watt rating for the new metallic filament lamps by the manufacturers. We have before stated on several occasions that this method of rating an electric lamp has neither logic, science, custom, nor ethics to back it up. To rate a lamp by the electric energy which it consumes is as illogical as to rate a workman's value by the amount of food that he eats, or the steam-engine by the amount of coal burnt in its boilers. The rating is unscientific, because it gives absolutely no information in regard to the ultimate purpose for which the lamp is made, namely, the production of light. It is not in accordance with custom, for the electric lamp has been rated by candle-power since its earliest commercial use, and lastly, the practice is not in accordance with good business ethics, because it is plainly suggestive of an effort to keep the public in ignorance of the actual performance of the lamp by rating it in terms with which the public is entirely unfamiliar.

The term "candle-power" in itself is ambiguous, and often used in a misleading manner, it is true; but much of this ambiguity and misunderstanding has been removed by the use of the term 16 c.p. in connection with the carbon filament lamp, which has reached a sale of 100 million a year. The general public have, therefore, come to associate a certain amount of light production with the term 16 c.p. For example, if a consumer were to light a given room or space, and were advised to use 50 c.p. lamps, his only method of approximating the number of units which he would require would be for him to make an estimate, rough though it might be, of the number of 16-c.p. lamps which would be required, and then use one-quarter as many 50 c.p. Although the 16 c.p. as a measurement refers only to horizontal intensity, the carbon filament lamp of this rating has been reduced to a practically uniform standard, namely, the "oval anchored filament" lamp, so that 16 c.p. has come to mean a pretty definite amount of light. This rating by horizontal measurement is comparable with the rating of the illuminating power of gas by a similar measurement on a gas flame.

The manufacturers of the Tungsten Lamp are making strong appeal to the purchasing public on account of its greater economy, which is generally stated

as a percentage. Their method of rating and labeling the lamps, however, gives the user absolutely no clue to the performance of the lamp as compared with that of the old style carbon lamps which he has been using. Why this omission? Does it not tend to create suspicion on the part of the public? Although it might be technically unscientific, a method of rating lamps in which the 16 c.p. lamp of the carbon filament type would be taken as the unit would give the public more definite information than any other rating that could be devised. A lamp of this type gives 13.2 mean spherical candle-power. A lamp, therefore, which gave 26.4M.S.C.P. would be rated as a 32 c.p. lamp. A 50 c.p. lamp would, therefore, be one which gave 50-16 times 13.2, or 41.2 M.S.C.P. The rating of lamps in this manner would offer no practical difficulties to the manufacture, since for any given type the reduction factor between mean horizontal and mean spherical is an easily obtained constant. Besides the candle-power, the watt consumption at the rated voltage should also be stated on the label.

## The Commercial Significance of the Tungsten Lamp

The tungsten lamp, which virtually reduces the electrical energy required in the production of light to 1-3 of what it has been in the past, is now an established commercial article. The question of how this will effect those engaged in the production of electrical energy is one which has elicited much attention and discussion. However opinions may differ on the subject, one fact is indisputable: the lamp is here, and here to stay. Whatever its effect may be commercially, it will have to be met by all whom it may concern. The lamp cannot be suppressed, nor even sensibly retared in its use by the public. Neither will the public submit to any material increase in the price of electrical energy. If the lamps can be manufactured in sufficiently large quantities, the immediate effect will doubtless be to reduce the income of the producers of current. But unless in this particular case history absolutely refuses to repeat itself, there need be no fear of ultimate reduction in the general profits to the producing companies. A number of compensating factors are discernible at once. First, the cheapening of electric light must inevitably enable the central stations to draw a certain amount of income that has heretofore gone to the account of the gas manufacturers. Again, the establishment of central stations in the smaller towns, and especially the utilization of water powers that have been heretofore neglected, will furnish a new source of revenue, which will to a certain extent draw from the fields now monopolized by illuminating oils. Probably the largest field for increase in the use of electric light is in public lighting. Compared with modern interior lighting, the illumination of streets and public parks at the present time is a relic of the dark ages. The few "show streets" that may be found in a considerable number of cities demonstrate how wide the opportunities for improvements in general street lighting are at the present time. In fact, most street lighting can only be properly designated as "beacon lighting," that is, the lights simply act as guides for following the streets, rather than illuminating them. Furthermore, the introduction of decorative and spectacular effects have but just begun, and are bound to assume very large proportions. Another source of increased use of electric light which is not to be neglected arises from the fact that the new lamps so closely approach daylight in their color effects as to render possible the operation of many industries "double turn," which at present can be carried on only with more or less difficulty and inefficiency by artificial light. The old prejudices against night work has very little foundation in fact, in view of the illumination possible by these new light-sources. Having practically the same visible qualities as sunlight, the hygienic effect is also practically the same. A number of the most important "fixed charges," including interest and depreciation, remain for single as for double turn, and as such charges usually hold the balance between profit and loss, their reduction is always a matter of serious concern to the manufacturer.

# Correspondence

## From Our London Correspondent

It will not be out of place to commence this month's letter with a short reference to the position of the Gas Light and Coke Company, the largest gas undertaking in the world. The increase in the sale of gas in the six months ended 31st of December last was only one per cent.; the gross quantity being 10,799,113,000 cubic feet against 10,684,724,000 sold in the corresponding period of 1906. Although the increase does not seem large the number of consumers show an advance of 14,736, and the additional gas stoves fixed has been 19,077. So it will be seen that the strenuous efforts made to extend the use of gas has been eminently satisfactory. For many years the governor, or chairman of the undertaking, was a layman, not an engineer; but the gentleman occupying that position now, Mr. Corbett Woodall, is a practical gas engineer who holds the premier position as a consulting and parliamentary adviser on gas matters in the United Kingdom. He has brought to bear upon the business of the company an experience extending over thirty years, and has attracted to the official staff many men of exceptional ability, who are doing their utmost to popularize gas and assist by every means in their power to educate consumers to obtain the fullest possible duty, whether for illumination or other purposes, from the gas they purchase, with the result that they really buy less gas and obtain more light or heat. At no time in the history of gas manufacture has the consumer been so satisfied as he is at present. As a matter of fact in all parts of the kingdom a wave of contentment and satisfaction has passed over the consumer. He feels that he is getting full value for his money; and what perhaps he is still better pleased with is the attention and courtesy he receives from the officials of gas companies. Lectures, demonstrations, personal visits from experts to instruct him, his wife and servants, are now the order of the day, with the result that business is improving.

The advent of the inverted gas burner is responsible for much of this new life; every week sees improvement in the construction and application of his burner. We know that on your side of the Atlantic the same success is being met with, and we cannot refrain from congratulating Mr. T. J. Litle, Jr., upon the admirable paper he recently contributed to the proceedings of the New York meeting of the National Commercial Gas Association, upon "Gas Lighting in the Factory;" that paper will be reproduced in the English journals devoted to gas matters, and read with the greatest interest by all who are working so hard here to advance the use of gas.

The subject of "Up-to-Date Shop Lighting by Gas" has been recently dealt with by the Chief Inspector of the Gas Light and Coke Company, Mr. F. W. Goodenough, a gentleman of the most remarkable energy and ability. He has been busying himself in delivering lectures before Tradesmen's Associations, dealing with window lighting. He referred to the use of reflector lights overhead, as in such a case the light was not obtrusive to the eye. The placing of eye cups underneath, he said, was an improvement, although not absolutely necessary; still in his opinion, such an arrangement was the refinement of gas lighting. It was especially good and applicable for illuminating goods set back on the floor of a

shop. In outside lighting he recommended that the lamps should be fixed well out from the window and not too high up. The rays of light most effective were those ranging from horizontal to an angle of forty-five degrees. The supply to such lamps should, he said, be regulated by means of a switch, so that half of the lights could be turned on if desired. He strongly advised the maintenance system; this method of attending to the upkeep of the burners and the supply of mantles has now become very general here, the gas companies keeping a staff of specially trained men who visit the consumer periodically to see that things are all O. K., and for this a small charge is made quarterly; repairs to burners, broken chimnies, new mantles and the cleaning of glassware are all covered in the charge. This system insures uniformity in pressure, a tested and proved brand of mantles, and glassware specially made to stand the enormous heat evolved when consuming gas in the incandescent burner. In the course of this particular lecture he instanced a case of railway company who had saved $4,800 (£1000) by installing modern gas lighting in place of electricity.

During the last few weeks attention has been called to a Methane mantle; the manufacture of methane is based upon the reaction of heated nickel and carbon monoxide, by which the carbon monoxide is converted into carbon dioxide and free carbon. The mantle which we illustrate differs from any on the market in appearance, and is formed by drawing out rods of thoria and ceria with other materials in much the same manner as the glass blower draws out glass. We understand that the composition of these rods or filaments is alumina precipitated by ammonia, 3 per cent.; glucine, 2 per cent.; silicate of alumina, 1 per cent.; theria, 92.8 per cent.; and ceria, 1.2 per cent. These mantles, we are told, have been used considerably in France. In form they are a bundle of filaments, or small rods from 1 to 1.2 inches, and 0.032 of an inch thick. They look like needles of glass or kaolin, and give the highest radiation at the temperature of the bunsen burner. It is stated that a bundle containing ten needles will give an illumination

FIG. 1.—METHANE MANTLE.

of from 50 to 60 candles. We are given to understand that when used with the Mecker bunsen burner, a duty of 10 caddles per 0.636 cubic foot of gas was obtained. The Methane mantle is quite new on the London market, a company having been recently registered to exploit it.

We know that much interest is taken by readers of THE ILLUMINATING ENGINEER in all new forms of fittings, especially for use with inverted burners. We illustrate two adjustable pendants which are being introduced by wholesale houses. Mr. Thomas Thorpe, a well known inventor of apparatus connected with photometry, in fact the inventor of the original Jet Photometer, has taken out a patent to protect burners. This plan, which can be followed by reference to the diagram, Fig. 2, is to surround the air inlets to the burner with a cylindrical case with wire gauze side walls and solid ends. A supply of air under slight pressure is conducted to this case, by a pipe which is fitted with a regulating tap. The air is preferably delivered into a conical or cylindrical shield in order to prevent it from spreading all at once, and to assure a sufficient supply of air under pressure to the mixing tube. The illustration that we give provides three methods of admitting the air. By

means of the tap the air entering the casing under pressure can be regulated so that there is a slight excess beyond what is really necessary for the requirements of the burner; this excess will then make its escape through the gauze wall of the casing. The very general use of this type of burner has made it absolutely necessary in some cases of shop and warehouse lighting to adopt a principle of filtration of the air supply. We should think that Mr. Thorpe is likely to obtain a large amount of support, as certainly his invention would appear to solve a difficulty.

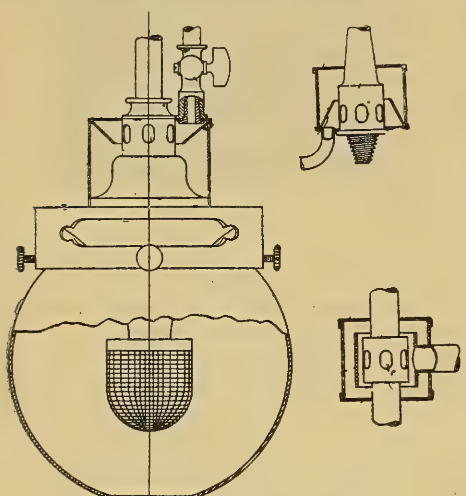


FIG. 2.

Some correspondence has appeared in one of the prominent papers connected with the ironmongers' trade upon the purchasing of incandescent mantles, and the need of knowing something about the article offered and the ingredients used in the manufacture. He says that it is most necessary to know what the impregnation of such mantles is. All mantles, he adds, are calculated for value by impregnation, the terms being 1000, 900, 800, 700 or 600 impregnations. The meaning of these figures is that in the preparation of 1000 "stockings" or mantles when treated will absorb or are impregnated with one kilo, of thorium; 900 or any other number meaning that they have absorbed the kilo, of thorium. The lesser the number of stockings absorbing the given quantity of thorium, the stronger they will be. It should also be understood that the impregnation only strengthens the mantle, and is not used for light giving. Still it is important to know the amount of thorium contained in the stocking before it is burned off.

CHARLES W. HASTINGS.

## From Our Readers

THE ILLUMINATING ENGINEER,
GENTLEMEN:

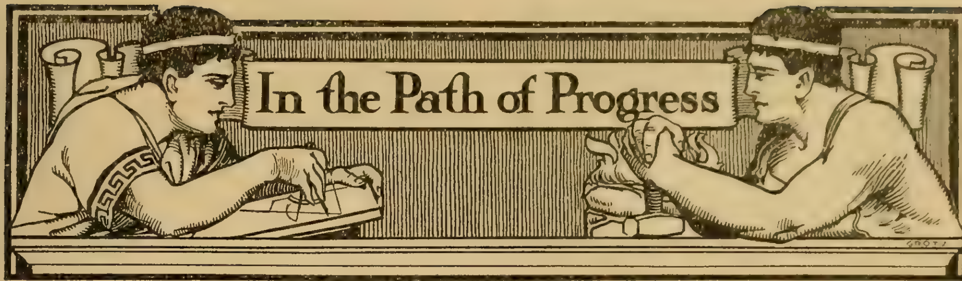
Someone has said that architects are born, not "made," and others that architects are "made," not born. Granted that either is correct, I fail to see where he has anything on the illuminating engineer. No one can dispute the first part of the first statement and until something very strange happens all men will be born, and I do not think architects will be any exception to this rule.

Practically every professional man who amounts to anything is a "made" man, and I can safely state that all illuminating engineers with whom it has been my good fortune to come in contact with, have been both born and "made." Necessity and demand "made" the illuminating engineer and he is here to stay.

Yours very truly,
W. S. KILMER.

## Might Have Been a Public Service Commissioner

DENTIST: "My charge for an extraction is half-a-crown. Five shillings extra if you have gas."
FARMER GILES (*who knows all about the price of gas*): "Good lor', sir, shall I want two thousand feet?"—*Punch.*




## General Progress During the Past Year

In order to obtain a general review of the year's progress in the lighting field a letter of inquiry was sent to a number of representative manufacturers, central station, and gas companies. The following replies have been received:

From E. W. Lloyed, of the Commonwealth Edison Company, Chicago.

The members of the Contract Department of the Commonwealth Edison Company have taken considerable interest in the subject of Illuminating Engineering during the past year. Several members of the department have made a careful study of the question, and I consider that the work done by them for the company has been very valuable. There is no doubt that a contract agent of an electric lighting company should make it his business to learn the underlying principles of Illuminating Engineering, as such knowledge would be of incalculable benefit to the lighting company. It is becoming more and more essential that the lighting company point out to its customers the advantages of correct information regarding the installation of different forms of illuminants. We can trace the obtaining of quite a number of good pieces of business to the work done by one of the members of this department in laying out the illumination of the premises of the consumer. As we learn more about this branch of engineering, the lighting company will rapidly learn the value of men having such information, and will require that their agents have some knowledge of this science.

The Commonwealth Edison Company has done nothing so far with the Tungsten lamp. It is scarcely time to express an opinion as to what influence it will have on the business, although I cannot see why it should accomplish anything but good for the lighting company. It seems to me that it will ultimately have the same influence on the electric lighting business that the Welsbach mantle had on the gas business. We are looking forward with considerable interest to the time when we shall be able to secure these lamps in sufficient quantities so that they may be used universally in large cities.

From what I can learn, business in Chicago does not seem to have suffered as much as in some of the eastern cities. Business is slowly but surely recovering from the shock of the recent panic, and it seems as if this would continue. We do not anticipate a rapid recovery but see no reason for believing that there will be any further falling off in business.

From W. Rawson Collier, of the Georgia Railway & Light Co.

As you know, the unusual financial depression exists in the South, just as it does with you, and this, added to the fact that the advent of prohibition on the first of the year seemed to make things very quiet in Atlanta, necessitates for our contract department very close and hard work just at present. However, I might state that last year was an extremely good year with us; our number of customers increased about 24 per cent., our number of incandescent lamps about 21 per cent., and our power load about 20 per cent.

Regarding the new forms of lamps, I would say that the Nernst lamp is slowly working its way into Atlanta and seems to be giving very good satisfaction, especially in the A. C. District. The Gem high efficiency lamp has been extremely popular

here for several years and the growth is very rapid, even now. Regarding the Tantalum and Tungsten lamps would say that these lamps have been on the market such a short time that I can give very little idea regarding their popularity in Atlanta. I feel confident, however, that the Tungsten lamp, especially in the 100-watt size, will prove one of the most popular, if not the most popular, of all the incandescent lamp family. This lamp, I think, will within the next two or three years, displace the arc lamp for store illumination to a great extent and if the cost of the lamp is later reduced, I feel that it will entirely supplant the present high efficiency lamp.

From J. D. Shattuck, of the Suburban Gas Company, Chester, Pa.

Replying to your letter of Feb. 27th, would say that from a gas engineer's standpoint, I think there has been a considerable advancement in the lighting business during the past year, particularly in the adoption of different forms of the new inverted gas burners. These burners are being applied in a good many very artistic methods; the principal advantage, however, is in the greater illumination given with a smaller gas consumption, than the upright burners give. The tendency to smoke ceilings seems to have been overcome with these burners, and I believe they are going to prove less costly to maintain.

I believe that outside lighting by both gas and electricity will be curtailed somewhat this year if the present industrial conditions continue. I think, however, that more business can be done in the lighting field, both in gas and electricity, by employing a larger number of smaller units instead of the glaring arc lights of both systems. This will come about through the natural study of economy on the part of store keepers.

In the house lighting business, I look for a very considerable growth due to the new designs of fixtures adopted for the inverted burners, as well as the inverted burner itself. I expect the gas industry, as a whole, to show an increase this year in output over 1907, in spite of the apparent depression in other industries, but it behooves us all to hustle and advertise.

From Carl H. Graf, of the Indianapolis Gas Company.

Replying to your favor of Feb. 27, would state that not being interested in electric illumination except as a competitor, we must naturally confine our remarks to the matter of illumination by gas.

One important feature, which is almost generally overlooked, is the willingness on the part of merchants and others who have adopted the gas arc method of lighting, to furnish a testimonial as to its efficiency and economy, and to have photographs taken of their places of business for advertising purposes, showing the gas arc in use. A few experts in psychology would assert that this willingness is traceable to a selfish realization of the opportunity to gratuitously advertise their own business by means of the publicity of the testimonials and the picture. Be this as it may, the favorable testimonial and recommendation count just the same as a means of influencing and securing new customers for the gas arc. In a booklet, issued by this company last year, fourteen of these illustrations and commendatory letters were published.

This collection of testimonials revealed another phase of the question which has escaped general notice and that is the remarkable saving that may result from the adoption of the gas arc method of illumination in some cases. It is the rule, in estimating the difference in cost between one system of lighting and another, to figure on the lowest rate of the competing method. This, as a principle, is probably a good plan to follow. But we are apt to overlook the larger saving and economy that rewards the convert who has been paying exorbitant rates for the abandoned method. The following testimonial will show this point very clearly:

The proprietor of a hotel writes: "I find that, with the installation of four 'Welsbach' 400 c.p. lights in our lobby, we have reduced our lighting expenses for this space at least 75 per cent. Prior to this installation, incandescent lamps were used, the current being furnished at a fair rate."

It is very advisable, therefore, wherever possible, to get to know the existing ex-

pense or monthly cost of the light used, and then to offer a careful and easily understood explanation of the gas arc economy.

With reference to incandescent gas lighting the outlook for the coming year is very encouraging. We have recently installed in the City Market (which is one of the largest in the country) thirty-one Welsbach gas arc lamps and fourteen reflex inverted lamps, these lamps replacing seventeen electric arc lamps and numerous open flame burners.

The cost of illuminating with these lamps from Jan. 20 to Feb. 24 was $76.63 against $173.71 for the corresponding period last year, showing a saving to the city of $97.48. This showing is very gratifying to the city and through it we are about to place 99 additional Welsbach gas arc lamps in the market.

With the inverted gas lamp we have been able to illuminate with gas some of the best stores in the city which we could not reach with the gas arc lamps. We have also been very successful in window illumination.

We are forwarding you a photograph of the window illumination of the Taylor Carpet Co., of this city. In the window on the right we have installed seventeen reflex lamps with angle shade against thirty-four 16 c.p. incandescent lamps in the wndow on the left. We will be pleased to have you use this photograph if you see fit.

We might also state that the sales we are having on inverted gas fixtures and dining-room domes equipped with the reflex lamps are very gratifying.

Notwithstanding the economy and general satisfaction of the incandescent type of gas burner, there are still a great many who prefer the open tip for certain kinds of illumination. In such cases we use our best endeavors to induce the consumer to use the "Bray" or some other type of check burner that is both economical and efficient.

From W. H. Gartley of the United Gas Improvement Company.

We are experiencing in the gas industry, at this time, one of the greatest practical advances that has been made in illuminating engineering for a generation.

It is the practice of many gas companies to put gas burners on the fixtures of their customers without charge—I speak of the open flame burner. Many of the companies have selected the Bray burner, and have distributed them among their consumers in enormous quantities. I know of one city that has placed over three millions on consumers' fixtures free, in the last ten years.

The Bray burner has distinct advantages over the slitted lava tip. Under excessive pressure the Bray burner does not throw out extended horizontal jets of flame, which break globes, but elongates in a vertical direction only. It is less likely to have a deposit of dust or foreign material in the aperture, causing the flame to fork, but, on the other hand, the Bray burner does not give as much light for the same consumption of gas as the ordinary lava tip, so that in the past the consumer has secured safety from fire at the expense of a certain amount of light.

The new design recently issued by the Bray Company (of England) has been improved by which all of the advantages of the old Bray burner are secured and as much light obtained from the gas as is given by the ordinary lava tip.

In view of the vast number of these burners in use throughout the country, this, to my mind, marks a very distinct advance in illuminating engineering from the gas point of view.

I might add—the claim that has been made that the old Bray burner gave as much light on an average during its life, as the lava tip, has not been found to be substantiated by experiments covering several years.

From Alonzo P. Ewing, of the Detroit City Gas Company.

During the year 1907 we showed a considerable gain in our illuminating business. As a matter of fact, we gained as many gas arc lamps during the year as the total number that the electric light company have on their lines now. From a reliable source we learn that they had 2,700 electric arcs in Detroit. A recent report of the municipal plant showed something like 3,600 electric arcs, or their

equivalent, on their lines. We estimate 1,500 electric arcs on isolated plants, making a total of 7,500 electric arcs, while we at present have 15,556 gas arc lamps. A large per cent of these are being cared for by us regularly each month, so that we are sure that they are being used and are in good condition.

The convenience of electric light in the home has shown its effect in the better class of houses. It has shown its effect in flats, in that the careless use of gas has made it expensive to the landlord in decorating. The inverted burner has opened to us the way to get back very much of this business, giving them the kind of light that they want, and without soiling the decorations.

We have tried a few of the small inverted burners, but the demand is for a high candle power, mellow light, which is easily adjusted, makes no noise, and is less sensitive to a slight variation in pressure. There would seem to be a large field for a small inverted burner, but this field is in the home that can well afford the extravagance of electricity, and in consequence the saving made is not always as interesting to them, in fact, not so interesting as the convenience of the button on the wall.

The moderate home is our large field today, and each month, even though the public are talking hard times, our sale of inverted burners has increased. We are replacing electricity from the economical standpoint, as well as from the kind and quality of light.

The inverted arc will open a new field, will give us something new to talk about, and give us an opportunity to make greater headway in the better grade of down town stores, both for inside and outside lighting. I am inclined to believe that a commercial lamp will be put on the market this year by at least one of the companies, that will meet the approval of the gas fraternity. The merchants generally are inclined to want to change from time to time, and unless we show them something new in a gas lamp, they try electricity; but if we can show them something new, —a different stack on their arc, or a different type of lamp, making a change that would appeal to them, we can renew their business for another year or two without their going to electricity.

From a commercial standpoint our orders have fallen off. We have not materially cut expenses, but it is necessary for our men to spend more time keeping business, and it takes more time to get new business; as a result we are selling fewer arcs than we did last year.

This company will move into its new building within two months, and will show for the first time, at least in Detroit, an eight-story building, lighted with the inverted burner, and with chandeliers and brackets that are operated simply from the key; turning the key lights the lamp without a by-pass by means of a concealed pilot system. All chandeliers on the first floor will be lighted with the same system, but the gas supply to the chandeliers will be controlled by the pneumatic valve. This new system is going to open up a field in the better class of houses, making it just as convenient to have gas light in each side light, as it is to have electricity. They have the advantage of giving a strong, mellow light to read by, and the small burners produce a decorative effect.

From A. Cressy Morrison, Secretary National Acetylene Assn.

As an indication of the progress of the acetylene industry, I take pleasure in enclosing a statement regarding a recent modification of the insurance rules, which is of great importance.

The recognition of acetylene as a common illuminant, the conclusion that it is safer than the illuminants which it replaces, and the modification of the insurance rules, are a tribute to inventive genius. An industry which has evolved from crudity to approaching mechanical perfection in ten years, and as an illuminant is installed in over 150,000 separate buildings in the United States, must be of interest to you.

The rules formulated by the National Board of Fire Underwriters for the acetylene industry have hitherto required outside installation of acetylene generators, and while, as a matter of fact, in by far the largest part of the United States this rule has not been insisted upon, in certain limited sections it has been rigidly enforced.

The existence of a rule prohibiting the installation of an acetylene generator in an insured building was a constant menace and handicap to the industry, and its enforcement in some sections and not in others placed insurance companies in the inconsistent position of insuring property in one state under conditions which it would not accept in another. An investigation by the National Board as to the exact condition of the industry, disclosed the fact that, in those sections where inside installation had been permitted, acetylene was proving itself to be a safer illuminant than those which it replaced.

The National Board of Fire Underwriters, at its executive committee meeting on January 30th, 1908, held in New York City, after considering the various favorable reports submitted to it by its various committees, amended the rules covering the installation and use of acetylene generators, by striking out such words as prohibited inside installation under all conditions and substituted the following: "Generators, especially in closely built up districts, should preferably be placed outside of insured buildings in generator houses constructed and located in compliance with Rule 9."

It will be seen at once that, while the National Board recommends outside installation as being ideal, in place of the absolute prohibition, the rules now mean that in all outlying districts generators may be placed inside, but in closely built-up districts it recommends outside installation as its preference.

Even where outside installation is preferred the rule regarding construction of generator houses has been modified, and where such houses formerly had to be fire proof, constructed of brick and located as far as practicable from other buildings, such houses may now be located adjoining an insured building and fire proof construction is not required.

It will be seen that the above modifications are radical and are a most favorable indication of the fact that inventive genius and a close adherence to the rules of the National Board of Fire Underwriters have received a deserved recognition.

The Acetylene industry has been subject to the rules of the National Board from its inception and has loyally endeavored to meet all insurance requirements, not only in letter but in spirit. The result has been a vast expansion of the industry and a growing safety of the illuminant until the above modifications were deemed warranted by the National Board.

From N. R. Birge, of the General Electric Company.

Replying to your letter of February 28, to the General Electric Company, would say the tendency during the past year, in connection with enclosed arc lamps, has been towards simplification, ruggedness, the use of fewer insulations and edgewise fireproof winding. Considerable progress has been made in these respects, and I consider the lamps much more satisfactory than those in use a year or two ago. The tendency has also been towards the use of larger units, and a large number of high current lamps, both D. C. and A. C., are now in use.

Magnetite lamps, both multiple and series, have been perfected and are now being used to a great extent for street lighting purposes. The efficiency is much higher than is secured with an enclosed arc lamp, and the cost of maintenance (due to long life of electrodes) somewhat less. The series luminous lamps consume about 310 watts, and the illumination is much better than that secured with a 480 watt carbon lamp.

A 110-volt multiple lamp with edgewise windings has been designed and is very popular not only for street lighting but for lighting foundries, train sheds or other places where the magnetite fumes are not objectionable. This lamp not only gives better illumination, but requires only 400 watts as against 550 for the 5-ampere carbon lamp. The lamp can also be used two in series on 200 volts, and with special windings can be used in multiple on 220-volt circuits.

A flame arc lamp of American design has also been perfected and is used to a great extent for advertising purposes and for the illumination of factories, foundries, etc., with excellent results.

In order to provide for the very heavy

demand for Edison lamps, and to take care of the new developments in Gem, Tantalum and Tungsten lamps, the General Electric Company have in the past year built four new factories at East Boston, Toledo, O.; Fort Wayne, Ind., and Newark, N. J.

The factory at Toledo is confined to the production of Gem filament lamps only. That of the Newark factory to Tungsten lamps only, and the factories at East Boston and Fort Wayne to the regular carbon filament lamps. In addition the General Electric Cohmpany has erected a new factory building at Harrison, N. J., adjoining the present lamp factory, which is devoted to the production of Tungsten lamps.

In addition to these new factories the main factory at Harrison, N. J., continues its large output of carbon and Gem filament lamps. The total productive facilities of the General Electric Company now aggregate sixty million lamps per year, so that they are in excellent position to supply all demands from customers.

From Alfred D. Childs, of the Cooper-Hewitt Electric Company.

We have your letter of Feb. 28th, and if you wish to include the Cooper Hewitt Mercury Vapor Lamp in your statement regarding the general progress in the arc lighting field possibly the following points would be of interest.

The color and quality of the Cooper Hewitt Lamp adapts it particularly to the field of industrial lighting. This includes mills of many kinds; machine shops, foundries, printing plants, etc. The lamps are also used in drafting rooms, offices, and have been installed in a number of post offices.

During the year of 1907 very considerable advance was made by the Cooper Hewitt Lamp in this particular field. Installations which numbered at first six or a dozen lamps, were run up to 200 or 300 lamps, and in addition, several new fields for the light were found to be open to the Mercury Vapor Lamp. Among these may be mentioned the lighting of silk mills. It was found that the changes in the colors produced by the lamp were not in any way detrimental and that the actual light obtained and the efficiency of the installation cannot be equalled by any other form of artificial lighting.

The number of lamps sold in 1907 more than doubles the sales of 1906, and there is every indication in spite of the falling off of business generally, that the sales for 1908 will more than equal those of last year.

From C. T. Eshelman, of the Jandus Electric Company.

Replying to your favor of the 28th ult., in regard to the status of the arc lamp situation during the past year, we have to advise that business in this particular field has been very gratifying, with the exception of the last several months. Of course, the depression has been general and we believe that other electrical interests have been affected in a like manner. As it is generally known, the lighting industry, both arc and incandescent, is tending toward the production of higher efficiency units. All arc lamp manufacturers are working not only to produce a metallic electrode arc, but are working to overcome the inherent defects which have retarded the progress of this new product.

Statistics show, of course, that notwithstanding the many artificial illuminants now marketed in competition with the enclosed arc lamp, the carbon arc business has been increasing from year to year and we are very much pleased to state that this company has secured a very fair share of this business, and we are not only pleased with the past, but feel that the future is very promising.

From G. B. Griffin, of the Westinghouse Electrical & Mfg. Co.

Referring to your letter of February 28th, regarding the developments and progress made in illuminating within the past year, would say that our endeavors have been directed towards a simplification of lamp mechanism, with a view of making lamps more rugged, with fewer parts than heretofore and where screws are used, to have standard threads and as few screws as possible, and where screws are used to have them interchangeable in various parts of the lamp so far as it is feasible also to have simpler and more permanent adjustments in the electrical

features of the lamp. For example: We are making a multiple A. C. lamp with a counter-balanced rocker arm and single coil with E-shaped armature, making the lamp interchangeable for 133, 60 or 40 cycles, for voltage ranges from 100 to 120 volts and current adjustment of 6, 6.5 and 7 amperes.

We have also made a successful effort toward improving the insulation of a lamp and making our standard breakdown tests considerably higher than is customary. This last statement, of course, applies particularly to the series A. C. lamp. We have also succeeded in making this lamp regulate very closely which improves the quality of light by increasing its steadiness. We have introduced a number of features on our constant current regulating transformers which we can supply on order, and if desired by the customer, we can make the transformer interchangeable both for frequency and current to the extent of having 133 cycle transformers which will operate equally well with a slight change in connection on 60 cycles and for either 6.6 or 7.5 amperes.

The most promising development in the field of illumination is, perhaps, our D. C. ampere Metallic Flame Lamp, which has already been well covered by articles in the trade papers and in papers presented before the central stations and engineering societies of the country. The lamps we are at present manufacturing have a very simple down-draft feature which is a modification of the original down-draft as developed by the Westinghouse Company and the resultant illumination obtained from the current consumed is comparable with that furnished by the 7.5 ampere series A. C. carbon arc. This statement with amplification indicates the saving which would be realized by the use of this lamp in lighting the ordinary city streets. This lamp is used on alternating current by the use of the Westinghouse mercury rectifying arc regulator, which is self-contained unit of external appearance very similar to the series A. C. constant current regulating transformer developed and furnished by the Westinghouse Company.

This briefly outlines what this company has done in the past year and should you desire, we can, of course, go more into detail, but assume that this brief statement is all that you wish.

From G. H. Retten, of the Helios Mfg. Company.

We are in receipt of your favor of the 28th instant, and in reply thereto would say that during the year 1907 several new types of arc lamps have been put on the market and have found ready sales. Flaming arc lamps have also increased in popularity, and the volume of trade throughout the first ten months of the year was extremely gratifying to all of the manufacturers of arc lamps; but during the later months, the volume of sales fell off in harmony with general market conditions.

On enclosed arc lighting no very great advances were made in the arc, nor in the details of the construction of the standard lamps, but the field for such lamps was very greatly extended, and a very satisfactory increase in gross volume of sales is recorded by all of the manufacturers.

Of flaming arc lamps the imported lamps, as well as the lamp manufactured by us, has met with considerable demand, and undoubtedly the use of lamps of this type will still further increase. At the present time there appears to be a fairly active demand for enclosed arc lamps consuming a somewhat smaller amount of current than the standard lamps, using a mechanism of a relatively small size and using a carbon of a small size, thereby working the carbon at a high density and increasing the illuminating efficiency, although this is of course done at the expense of the carbon life. The distribution of light from a lamp of this type is very good, and when aided by scientific reflectors, can be made to accord with the suggestions of our most prominent illuminating engineers. We have been called on by so many parties to produce a lamp of this type that we have concluded to enter the field, and expect to have our lamp ready for the market in about two months from this date.

We realize that the above does not show any very great progress for the year 1907, but it has been the experience in all lines

of trade that the improvements on various articles come by leaps and bounds rather than by a gradual process. The advent of the flaming arc lamp will undoubtedly spur the manufacturers on to further efforts to improve the features of the enclosed lamps.

We might conclude by stating that the lamps having the metallic filaments have also found sales in certain quarters, but the conclusion of the most prominent engineers is that lamps of this type are not yet sufficiently perfected to warrant any very extended use. The fact that they cannot be used on alternating current is also a feature which must be considered in working out the efficiency of a lamp of this type.

FROM H. M. HIRSCHBERG, OF THE EXCELLO ARC LAMP COMPANY.

The demand for Flaming Arc Lamps during the year 1907, in spite of the money stringency in the last quarter of the year, showed a very remarkable growth. We have sold sufficient lamps to bring the output up to five figures. There are many indications that the flaming arc lamp will soon be adopted in this country for street lighting, as it has already been abroad. Many projects are now on foot for such illumination.

FROM H. M. HIRSCHBERG, OF THE EX-CANDESCENT LAMP COMPANY.

Replying to your favor of the 26th instant asking for a statement from us on the general progress made in our line in illumination during the past year, we have been devoting considerable attention to exploiting the Tantalum lamp, with fairly good success.

We have found that the Tantalum lamp gives satisfactory service, in most cases, on alternating current circuits. For residence lighting it is particularly desirable, as the quality of the light is much superior to that of the carbon filament lamp, and the saving in current makes quite a marked difference in the cost of lighting.

For the last three months in the year we have been supplying Tungsten lamps, and judge from the amount of business we have secured that the demand for the Tungsten lamp is going to be very great.

We have had very little complaint from breakage in transportation, and up to the present time have not had a single complaint of short life from the lamps which we have sent out. We conclude from this and from our laboratory experiments that the life of the Sunbeam Tungsten lamp is going to be very satisfactory.

While we have not thought it best, up to the present time, to recommend our Tungsten lamp for use in any other position except vertical, the experiments that have been made in our laboratory and elsewhere indicate that it can be used successfully in a horizontal position, or at an angle of 45 degrees, and that the life of the Tungsten lamp in these positions will be fully as long as when suspended vertically with the filament hanging down.

There is a great demand for Tungsten lamps from textile factories, due to the fact that colors can be matched by the rays of the Tungsten lamp almost as well as by daylight.

The use of the Tungsten, Tantalum and other high efficiency lamps has not reduced the demand for carbon filament lamps to any great extent, and the indications are that the new lamps will be used very largely to increase the quantity of light furnished, and to replace the use of gas for illuminating purposes.

FROM N. L. NORRIS, OF THE BANNER ELECTRIC COMPANY.

Answering your inquiry of Feb. 25th relative to the general progress made in our line, we have to advise that, although our line includes 50 watt and high candle power metalized filament lamps, and Tantalum lamps, it is our opinion that of the new Tungsten lamp which has recently been brought out is bound to surpass all others in popularity with the lamp buying public. We have already sold quite a number of these lamps, and we have as yet to receive the first complaint in regard to their performance under actual usage. The difficulty which was first experienced in shipping these lamps without breakage has been very largely overcome, so that there is but little cause for complaint along this line.

Taking into consideration the great economy which can be secured in the use of these lamps, and also the very superior

quality of the light produced, we believe that it is to the advantage of all purchasers of incandescent lamps to adopt the use of Tungsten lamps for general lighting. Although the demand for this type of lamp has exceeded the supply thus far, arrangements are being made whereby the lamps will be produced in very much greater quantities, so that it will only be a matter of a very short time until orders for Tungsten lamps can be filled promptly.

FROM J. C. FISH, OF THE SHELBY ELECTRIC COMPANY.

Conditions indicate that within the last few months everybody that thinks upon the subject is thinking more of the desirability of light delivered beneath the lamps. The ideas first introduced among lamp manufacturers by this company, and so widely advertised by the Holophane Glass Company, are now generally accepted.

Central lighting stations are progressing in the right direction by adopting the new types of lamps, and in spite of the general business depression, the sales of Useful Light Lamps, Shelby Gem Metallized Flament Lamps, Shelby Tantalum Lamps and Shelby Tungsten Lamps are constantly increasing.

Light users are demanding more for their money than ever before and while a few central stations are in doubt as to the advisability of supplying Tantalum and Tungsten lamps to their customers, all central stations are considering carefully every change that can be made to improve their service to their customers.

The next year is going to show most remarkable changes in illumination. There is no question but what the Tungsten lamp will, eventually, displace the carbon filament lamp in most places and that carbon filament lamps that remain in service will be lamps designed to deliver the light beneath.

FROM E. J. KULAS, OF THE BRILLIANT ELECTRIC COMPANY.

It has been a great satisfaction to be at the head of an organization such as the company I represent and see the tremendous progress that has been made in practically one year. During this time we have erected a tremendous new plant at Conneaut, Ohio, which is one of the largest incandescent lamp contracts in the U. S.

This plant was constructed with every consideration for the manufacture of high-grade incandescent lamps and is equipped with the latest machinery on the market for lamp making. This plant was no sooner completed when the demand came for the Tungsten lamp, and we have recently decided to manufacture Tungsten lamps in our new factory so far as the space will permit.

FROM V. R. LANSINGH, OF THE HOLOPHANE GLASS COMPANY.

We have your favor of the 26th inst. in reference to our effort in regard to the Tungsten lamps. Up to this date we have not made any advance whatsoever in this line. We hope, however, to perfect a process a little later so that we will be able to supply street series lamps with the Tungsten filaments.

In spite of the very material depression throughout the country, the Holophane Company has continued to increase its business practically without interruption. We have increased from fifty to one hundred and fifty per cent each month over corresponding months a year ago, and this increase is held, despite the fact that individual orders have been much smaller than last year.

The company has spent no little time and energy in the development of new globes and reflectors, particularly of size and shapes suitable for tungsten lamps and other high efficiency units, this addition to the line also including a number especially designed to harmonize with prevailing architectural treatments. The company's idea being that, as its product is more and more receiving consideration by the architects and becoming a part of their specifications, no pains should be spared to place at the architect's command a wider variety of sizes and shapes.

Among the recent developments also are the enamel and sand blast finishes which the new high efficiency lamps render almost necessary owing to their high brilliancy. These finishes are becoming very popular as the public appreciates the necessity of getting down the intrinsic brilliancy of all lighting units.

The most recent addition to the Holophane line is the street lighting reflector, No. 243, which has just been placed upon the market. The Engineering Department of the Holophane Company considers this reflector as revolutionary, in what it accomplishes, both its vertical and horizontal distribution being as nearly ideal as can be well imagined.

The work in the Engineering Department, Holophane Company, has been multiplied by ten within the past few months. This Department's work consists not alone in developing new reflectors and globes, but also in assisting architects and others in the proper laying out of lighting installations. The Department now works in cooperation with some of the best known architects in the country and its advice is constantly being sought after on all points relating to light and illumination. Several young engineers are being trained up in this Department at the present time in anticipation of still larger growth.

One department of the Holophane Company which can hardly be defined either as salesmanship or engineering, is being developed by Mr. F. W. Loomis, formerly commercial manager of the southeastern lighting plants of Messrs. Stone and Webster, Boston. Mr. Loomis' work consists in visiting and advising with central stations, demonstrating the advantages of Holophane to the customers of such stations, and assisting the local managers in remodelling unsatisfactory lighting installations.

The Export Department of the Holophane Company has been placed under the direction of Mr. W. T. Chapman and Mr. A. H. Keleher. Mr. Chapman will have charge of the export business of the Far East, and in this connection will shortly start on a trip which will carry him to the seaport cities of Japan, China, India, and other eastern countries. Mr. Keleher is in charge of the business in Cuba, Mexico, and South America, which countries have recently developed favorably indications of a demand for Holophane.

Mr. V. R. Lansingh, General Manager of the Holophane Company, Sales Department, expresses himself as altogether optimistic in regard to the future not alone of his own company but of all business. It is inevitable that a certain depression should exist after so serious a financial disturbance as the country passed through last foll and this depression will serve to solidify business as a whole and marks, he believes, the beginning of a new era of prosperity.

From Norman Macbeth, of the Illumination Improvement Company.

From our standpoint illuminating engineering has made a very considerable and exceedingly satisfactory advance during the past year.

Manufacturers of lighting accessories, gas and electric companies, have shown their appreciation of the movement by their eagerness to corral the present supply of illuminating engineers and are paying considerable attention to the education and advancement of those of their salesmen and men, who are not in the "satisfied with past achievements" rut, and give promise of developing into good material.

The awakening of the architect, fixture designer and contractor is coming along, as shown by the ever increasing membership of the various sections of the Illuminating Engineering Society; the one place where the diversified interests may thrash out their differences to their mutual advantage.

If the installation of prismatic glassware will enable a reduction in the maintenance, which in a few months is sufficient to offset that considerable expense plus the fee of the "prismatic illuminating engineer," the man who has paid his architect or contractor for specifying and installing the highly artistic conceptions, which so recently beautiful are now scrap, and which were installed with an apparent disregard of the actual commercial use and cost of maintenance, is liable to question his investment and fail to appreciate the full value of the artist's conception. Many lighting accessories resemble some of nature's freaks, so handsome and artistic as to defeat the purpose for which they were designed. Note the wall brackets in the Pennsylvania State Capitol, which have been turned upside down in the endeavor to squeeze some useful illumination from fixtures which were de-

signed in true accord with the architect's conception of the artistic and aesthetic. The efficient fixture, accessory or installation may be considered from the standpoint of "handsome is as handsome does."

The awakening of the man who supports the lighting fraternity, the consumer, is also acknowledged, and after all he is the man who finally decides. Today he wants high intrinsic brilliancy and glare; the goods are being delivered, as low hanging flame arcs and bare tungsten lamps so silently and effectively testify on many of our streets and windows.

Many consumers are induced to accept the services of the Public Utility Company's illuminating engineers and lighting experts, which service will be rendered gratis. The company realize that by so doing they continue to have a finger on the pulse of that mighty important man whose regular monthly or quarterly check is so necessary. Many of these companies, who a few years ago would maintain that their interest ceased at the point where connection was made with the consumer's service, that their energy was worth so much per K.W. and totally disregard the "value received" standpoint, are now quite willing to agree that light and illumination is a marketable commodity, if the possibility of charging for same on a sixteen candle-power lamp hour basis can be arranged, generously granting the consideration which would have been received so favorably a few years ago of 3.1 watts per candle power. This would result in five hours use of installation, with carbon filament lamps being credited as two hours with tungsten lamps.

The farsighted, dividend producing, contract man of the concern supplying the energy should not be lost sight of. In a recent installation, satisfactory illumination was secured, using four watt refilled lamps of the common garden variety, with better results, and at a lower net maintenance cost $\frac{\text{\$ per month}}{\text{required ft. c.X. Area of Plane}}$ than would be possible with either 1¼-watt tungsten lamps, "guaranteed 1000-hour life," or Welsbach reflex burners. The cost of the energy was based on an agreement for current at the seemingly reasonable rate of 6 cents per 1000-watt hours, *with a proviso*, however, which would bring the current cost with tungsten lamps to possibly 18 cents, or if reflex burners were installed, wherever the greater flux of light from this unit would be useful and desirable, this elastic 6 cents might become $1.

Will the illuminating engineer succeed in blazing a more aesthetic trail during 1908? We hope so.

From Jno. C. D. Clark, of the People's Gas Light & Coke Co., Chicago.

Your letter of Feb. 27th, with reference to an article for the March issue of the Illuminating Engineer has finally been received by me. This followed me around quite a little bit, and I regret that it has arrived so late and do not suppose it will be possible to do anything in time for your March issue.

In reference to the business outlook for the coming year, I think I can say to you frankly in regard to the lighting field in Chicago, there is no question about it,—it is going to be booming. All our business houses, business men's associations and store keepers in general, are demanding improved lighting conditions, and of course we are doing our best to help them out.

Lighting the business places in our city is considered necessary in advertising a place of business. Of course, all merchants like to obtain the best location in the city, and the others who have not the best locations have to do the next best thing; make their location appear to be as good as the best. As you know, there is nothing that will accomplish this so well as having the store well lighted.

I have taken up the other matter contained in your letter and have asked several of our people to see what can be gotten out, and just a little bit later will be able to forward it to you.

## Instruction in Illuminating Engineering in the Technical Schools

From Prof. W. E. Wickenden, University of Wisconsin.

The progress of the great technical industries is very strongly reflected in the

development of the engineering education from which their vitality has been so largely drawn. Doubtless the advance of illuminating engineering will be similarly dependent upon the degree of interest and attention it is accorded in the educational realm and upon the demand it is able to make upon the universities for men whose professional training has been planned with especial reference to its needs and problems. Such a demand has not yet passed beyond the realm of things prophetic and it will probably be many years before extended courses of study are planned with a view to the training of illuminating engineers as such. On the other hand, the time is now at hand for a generous increase in the attention given to this important field in the regular engineering curricula. Whatever of the activities of their professions may fail to find a place in the experience of the electrical or the gas engineer, the problem of artificial lighting is almost certain to demand more or less attention. There are elements of inconsistency in any curriculum which provides careful training in the conditions of efficient power production or gas manufacture but entirely disregards the principles which underlie the effective use of these products for lighting. While such conditions prevail it is little source of wonder that engineers who will conscientiously expend their thought and skill, as well as the funds of their clients, for the gain of a small percentage in the gross efficiency of the generating plant will at the same time plan and install systems of illumination which are both wasteful of energy and poorly adapted to the purposes of vision.

For several years past the University of Wisconsin has been developing courses with a view to providing for students in chemical and electrical engineering a thorough grounding in the principles of effective illumination. The immediate aim of this work has not been the production of specialized illuminating engineers, for it is realized that in no profession is experience and trained judgment more essential to the solution of the many special problems which are presented, but it is rather to give the student a familiar grasp of the laws and processes involved in the production of light, its measurement and its effective utilization. The degree of interest aroused by this course, which is elective for seniors, may be judged from the fact that during the present year nearly forty men have availed themselves of its opportunities in a highly creditable manner.

The following synopsis of a course now in progress will serve to illustrate the methods employed, the topics treated and the points of special emphasis. The lack of an adequate text-book makes necessary a combination of the lecture and seminary method in the work of the class room. Supplementary mimeographed notes embody in concise form the essentials of the lectures. Wherever possible illustrative problems are assigned, these having been found of especial value in dealing with the application of polar distribution curves and Rousseau diagrams, the use of the concepts and units of luminous flux, the calculations of illumination, the economics and illuminating value of various units and the design of typical systems of illumination. The general topics treated in the class room follow the following order: The nature and scope of illuminating engineering; the elements of light, its production and the phenomena of its propagation; the concepts, units and terminology of light and illumination; the principles of vision and the physiological features of illumination; photometric devices and their use; standard sources of luminous intensity; the representation and application of photometric data; the Rousseau diagram and its applications; the calculations of illumination; the thermodynamics of light production by incandescence and luminescence; incandescent electric illuminants—their materials, manufacture, accessories, thermal characteristics, operating characteristics, rating, performance at different frequencies, testing, color values, and a comparative resumé of their economies of operation and their illuminating value; the properties and characteristics of carbon, luminous and mercury arcs, and of vapor and vacuum tube illuminants; gas and gas illuminants; shades, reflectors and fixtures; general considerations and methods of design for various classes of interior

illumination, illustrated by the preparation of plans for class room discussion; street lighting; decorative and display lighting; and the elementary principles of art applicable to illumination.

Supplementary to this course of class room exercises is a series of experiments in the photometric laboratory of which the following list is typical: A comparative study of the principles, structure, sensitiveness and applicability of photometric screens of the types most commonly used; distribution curves of incandescent lamps; characteristic curves of lamps of different filaments; standardization of incandescent lamps by a hefner standard; tests to determine the conformity of a given lot of lamps to standard specifications of rating, efficiency, etc.; tests of the operating characteristics and light distribution of Nernst lamps; tests of spherical candle-power and hemispherical candle-power by the Rousseau diagram and by the intetests of interior illumination and street grating photometer; tests of shades and reflectors for efficiency, light distribution and intrinsic brilliancy; the calibration and use of the Weber photometer; illumination; tests of gas illuminants; tests of the mercury vapor arc; photometric test of the enclosed or luminous arc.

Much of the interest and emphasis of the course is placed upon the application of the principles developed to relatively simple problems of design. To each pair of students is furnished a plan and description of a building and a statement of the gas or electric service conditions available. Near the end of the course several sessions are devoted to a discussion of these plans. The students to whom they were assigned are required to point out the considerations demanding attention in the illumination to be provided, to discuss the alternatives considered and to describe the system recommended. The plans are then freely discussed and criticized by the class. During the past semester the following plans were considered: a machine shop and foundry; a retail store, a church, a college building, a theater, a residence, an assembly hall, a public library and a public square and the adjoining streets. Some excellent discussions ensued and the intelligent interest evinced would have been creditable to a session of a section of the Illuminating Engineering Society.

The plans for the extension of the work include a laboratory course in the photometry of gas and oil illuminants, which is expected to be of especial interest to students in chemical engineering. Should the demand warrant, a course in the practical elements of illumination will be offered in the coming summer session for the benefit of the practical electrical workers who usually are in attendance. A correspondence course in lighting, in which many of the practical elements of the course above outlined will be given, is projected by the university extension department.

From Prof. Henry B. Dates, Care School of Applied Science.

In answer toyour favor of Feb. 29, we are giving our senior electrical students a course in illumination.

In this course we are trying to introduce our men to the subject and acquaint them with its problems.

Aside from the lectures and reference work, we solve a considerable number of practical problems.

In discussing the various illumination problems we make a good many inspection trips to various office buildings, stores, factories, etc., to study the problems as far as possible first hand.

The time at our disposal does not allow of an exhaustive study of the subject. It has been my aim to have our students go out, with some knowledge of the subject, an introduction to its problems and impressed with its importance.

I enclose clipping from our catalogue, showng time given to subject, reference book used, etc.

314. Illumination and Photometry.—Senior year; first term, 2 hours a week. Cravath and Lansingh: *Practical Illumination;* Stine: *Photometric Measurements.* Professor Dates. (301, 307.)

A discussion of the theory, construction and performance of the electrical illuminants, including the various types of incandescent, Nernst, arc and vapor lamps. This is followed by a study of their applications to illuminating purposes, the effect of shades and reflectors, and a brief discussion of principles of photometry.

From Prof. A. J. Wurtz, Carnegie Institute.

Replying to your letter of Feb. 29th, I may say that although these schools are still in their infancy, they are, nevertheless, aiming to make illuminating engineering an important part of their work. We fully appreciate the great future in this field of work, and to that end are making our instruction as practical as possible; teaching students not only the use of the photometer but also the proper distribution of light, and leading him to make light and efficiency tests with various lamps, so that he may be in a position to handle these illuminants with intelligence; furthermore, through the medium of many lantern slides, we present to the students' minds the many branches or types of illumination in the illuminating field of engineering, such as large interior illumination, store lighting, factory lighting, window lighting, art gallery lighting, street lighting, sign lighting, etc., pointing out at the same time, the defects and advantages as they are presented.

From Prof. Geo. F. Sever, Columbia University.

Your letter of February 29th at hand, and in reply thereto would say that in our department of physics very complete instruction is given in photometry. The Electrical Engineering Department gives instruction in the accurate measurement of candle power of gas, incandescent, and in so far as possible, arc lamps. The department has an excellent equipment for this purpose. Lectures are also given by Professor Crocker covering the subject of illumination, and this work is supplemented by laboratory work in actual measurements.

From Prof. E. L. Nichols, Cornell University.

At Cornell University a course of lectures throughout the second term of the senior year is devoted to the principles of photometry and illumination. In this course the physics of artificial light sources, together with the methods of investigating the same as regards the quality of light and efficiency is given special prominence. Photometry and the measurement of illumination form a regular part of the prescribed laboratory work in physics for engineers and facilities are offered for special studies of the problems relating to this science which remain to be investigated.

From Prof. Albert E. Ganz, Stevens Institute of Technology.

I have your favor of Feb. 29. In regard to our work at Stevens Institute I beg to say that we do not have any specific course in Illuminating Engineering, but touch upon this as far as is possible in our regular course in physics and in electrical engineering.

From Prof. Dougald C. Jackson, Mass. Institute of Technology.

I have received your letter of February 29th making an inquiry on behalf of The Illuminating Engineer in regard to the instruction in Illumination which is given at the Massachusetts Institute of Technology. We have no formal course in illumination, but the students are given a considerable amount of theoretical and practical work in the class room, and some training in photometry in connection with their regular laboratory work. The class room work includes such things as computing illumination and plotting profiles and illuminating contour lines.

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## *Taxation without Representation.*

From the best statistics available it appears that the total expenditure, directly and indirectly, for the production of light in this country amounts to half a billion dollars yearly, and the per capita amount paid for luminants alone, apparatus and accessories not being counted, is $4.00 per year. A conservative estimate of the losses incurred by faulty methods of generating and utilizing artificial light reaches the astounding figure of $36,000,000 annually, and twice this amount is probably nearer the truth. Of the many reflections to which the consideration of these figures may give rise, none is more curious than the fact that, until the appearance of The Illuminating Engineer two years ago, there was not in the whole world a periodical devoted especially and exclusively to the production and utilization of light.

CASHIER BOOKKEEPER CONTRACTS ADVERTISING

# Commercial Engineering of Illumination

## 'THE CALL OF 'THE WILD.''


"The salesman regularly supplies the electric spark which keeps the commercial engine going."

"The man who tears down reputations always gets most of the dirt himself. What a jolly world of grand morals this would be if every man came up to the standard of perfection he fixes for his neighbor."

"Spasmodic attempts to get business rarely succeed permanently. It is the deliberate moving, cautiously, gradually, and intelligently, that makes the final success."

"It's a good thing for the man who looks at the corns on his hands to remember that on Easy street the corns are on the heart."—*Moody.*

## Book Review

MEN WHO SELL THINGS. By Walter D. Moody. A. C. McClurg & Co., Chicago. Price, $1.00, net.

We have heard a great deal of late of the science and art of salesmanship. Numerous books have treated the subject; periodicals have devoted their entire energies to this field; and institutions have sprung up expressly for the purpose of teaching the subject either by personal instruction or correspondence. Much of this has undoubtedly been pure theory, evolved from the inner consciousness of those fertile minds gifted with the art of telling others how to do that which they cannot do themselves.

The little book bearing the title above is a refreshing variation in the general type of academic discussions of the matter. The writer's familiarity with the whole subject, and his ability to say something worth listening to, is established by his own success in every step of his career, which began as a stock boy and has led through various degrees of salesmanship to the general management of huge enterprises. The book is the condensed results of his long and successful experience. It makes no attempt at any scientific analysis or classification of the subject, but simply tells in straightforward and convincing language the various elements which make for success or failure. That he takes a high view of the work of the salesman is to be expected, and forms one of the chief attractions of his writing. This is well expressed in the fore-word, which we reproduce in full:

When a man has taken the "third degree" in the science of salesmanship, has put finishing touches on a career of strapping and unstrapping cases in hot summers and chilly winters, has taken a course in hard knocks at the College of Give-and-Take; after he has been *frappéed* by below-zero receptions; after he has simmered in the caldron of competition; after he has set his foot on the path that leads to the summit of the mountain peak Success; after he has taken his post-graduate training in seeing Hope deferred,—I believe he should have the degree of Commercial Ambassador brought to him on a golden salver, for he is now a professor in the gentle arts of Peace and Plenty.

If you will recall the definition of Ambassador as set down in the dictionaries, it signifies an envoy of the highest rank sent by one government to another for the advantage of both. If there is anybody in the world who knows more about diplomacy than the men who sell things, knows more of dexterity, skill, and tact, more of the art of conducting negotiations, I will cheerfully waive the title of Ambassador and return to those of Traveling Man and Drummer.

But, even then, is not every salesman worthy the name, an envoy of the highest rank sent by one house to another?

Herald, then, the Commercial Ambassador! He is the herald and harbinger of the good things in the world—all of them. When he stops bumping the ties hotels will hang out "To Let" signs, railroads will have salt-watered stock, and storekeepers everywhere will raise cobwebs in their ship-windows. He keeps going—and he keeps all the rest going. He is the Ambassador Extraordinary and Plenipotentiary.

What, then, of the man who sends back the Ambassador's card by an office-boy, who turns his back upon him, who curtly refuses him a look-in? Such a man fails absolutely to safeguard the interests of his customers, proves him ignorant of his own welfare, and into the bargain cheats himself out of the rich storehouse of knowledge that can be entered only through the magic key intrusted to the Commercial Ambassador—that daily reviewer of the results of human endeavor of every sort, from desperate failure to brilliant success. Hoch der Ambassador!

The book is well worth reading as a literary production, and as a tonic and nerve food for the beginner or faint-hearted, it is worth many times its price; while even the most finished "commercial ambassador" will find much in the way of encouragement and instruction. We most heartily commend the book to all those engaged in the great work of "selling things."

## Westinghouse Lamp Company Receivers Discharged

The Westinghouse Lamp Company announces that the New Jersey and New York Circuit Courts have ordered the discharge of the company's receivers and the return of the property to the stockholders. These orders become effective March 1st, 1908, and after that date the management of the company will be conducted by the executive officers as prior to the receivership.

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DISCUSSION

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## Merchandise and Illumination

By Barnard H. Stowe.

While illumination is but one of the several elements that enters into a mercantile undertaking, it is and can be made a "feature" that will be appreciated by the purchasing public. By "feature" we do not mean an element that excites curiosity. "Features," in the popular sense, soon grow old and as the illumination of our modern establishments involves a considerable installation expense, the cost of new features as the old fail to interest the public would be burdensome. But the illumination of a store may be a feature in the sense that it is not too brilliantly lighted, or that there is not insufficient light: in other words, an illumination of which the customer is unconscious. Such illumination is manifestly equivalent to daylight or perhaps average daylight for such is our standard and that for which the human eye is physiologically adapted.

'Tis the unprogressive merchant who accounts his monthly lighting bills as fixed charges and not as representing a commodity appealing to his patrons fully as much as the goods on his counters. His lighting bills should be measured in terms of his gross sales on the ground that good light results in increased sales. By good light we do not mean overabundance. Too much light is a positive defect in illumination. Light is good or bad only as it compares with average daylight. To the merchant, that light is good only as it enables his patrons to select goods on the counter and bad as it impels in them a desire to carry the goods to the window or door where true color values may be obtained. Indeed that light is best of which the shopper is unconscious. A want of sufficient light or a light possessing peculiarities of color which attracts the customers' attention defeats the purpose for which the merchant illuminates his store.

Of the various devices used for purposes of illumination in stores and large spaces, the Arc Electric Lamp occupies first place.

The incandescent lamp occupies an enormous field in which it is easily the best and most convenient illuminant. Recent meretricious attempts to exaggerate the efficiency of clusters or groups of incandescent lamps with various diffusing devices are therefore all the more objectionable and blameworthy. Under similar conditions and allowing equally for deterioration, the fact cannot be controverted that the Enclosed Arc Lamp will yield at least double the efficiency of the grouped incandescent lamps.

Notwithstanding all that has been said and written in favor of the arc light, in point of efficiency, color characteristic, control, etc., the use of gas is still quite prevalent in the small cities. The modern device carrying four Welsbach mantles and called the "gas arc" seems to be very popular, and the reason for such popularity may be found in the low cost of maintenance. On a basis of cost of gas per lamp hour, mantle lighting involves the least expense, and on its face value, appeals to many merchants. Such considerations of cost find expression in the class of help employed, in the efficiency of the delivery system and in the general atmosphere of the store. To be more specific, we might say that gas lamps help to cheapen and also to cheapen the help.


# American Items

Metal Filament Lamps, by A. B. Adams, *Municipal Journal and Engineer*, March.

Comparing Tungsten filaments with mantle gas lamps, on the assumption that the light of the 60-candle-power Tungsten is fully equal to that of the mantle lamp using 3.5 feet of gas per hour, for 4,000 hours of lighting per year the Tungsten lamp will consume 324 kilowatt hours, costing $19.44 if the electric service is rendered at the rate of 6 cents per kilowatt hour to cover energy, care and renewals. The mantle lamp using 3.5 feet of gas per hour will burn 14,000 feet during the 4,000 hours of lighting, amounting to $14 at $1 per thousand, or to $10.50 at 75 cents per thousand feet. If the renewal of mantles and the use, repair and lighting and extinguishing of the gas lamps is fixed at three cents per lamp per night, or $10.95 per year, the figures used in the recent Buffalo contract, the total cost per lamp will be $21.45 per year with gas at 75 cents per one thousand feet, and $24.95 with gas at $1 per thousand. Even at two cents per lamp per night, or $7.30 per year, for the use and care of the gas lamps, the light of the mantle will cost $17.80 with gas at 75 cents per thousand, or $21.30 with gas at $1, per year of 4,000 hours.

The Tungsten lamp giving 60 candle-power in a direction 10 degrees below the horizontal, and located 15 feet above the surface of the street, yields .02 candle foot at a distance of 52 feet from its standard, so that the distance between such lamps will be 104 feet for the minimum illumination named.

It thus appears that for an illumination of .02 candle foot at points midway between lamps, on surfaces at right angles to the rays of light, there must be 2.3 times as many Tungsten lamps as there would be of enclosed arcs per mile of streets. While the enclosed arc lamp operates 400 watts, the necessary Tungsten lamps to give the same minimum light will consume only 180 watts, or 46 per cent. of the power at the arc. With the same rate for electric energy, including service, with either of these lamps, the Tungsten filament will save 54 per cent. of the cost and operaitng energy of the arc for the same light between lamps.

Five of the Tungsten lamps, taking energy at the same rate as one arc, might replace it on each 240 feet of street, and would then be only 48 feet apart. At points midway between these Tungsten lamps the illumination would be .075 candle foot, or nearly four times that at points midway between the arcs, and the general effect would be far more pleasing with the former.

Measuring Gas Light and Heat, by J. B. Klunpp, *Public Service*, March.

The following is an editorial comment on the subject:

That it is possible to cheat consumers in the quality of gas without incurring risk of detection is a common fallacy. Modern gas practice leaves nothing to guesswork and is governed by the exacting rules of science. Gas light, heat and pressure are not things of opinion but matters of certitude. Whether faults are with the gas or in the way it is used can be ascertained quickly and surely. Mr. Klumpp, who is a gas engineer of international reputation, gives an idea of how the lighting and heating values are determined. If a community thinks it is getting inferior gas service the question can be answered very simply. It is as easy for the authorities to enforce good service as it is to enforce the legal maximum rate. Those who attribute mysterious and weird properties to gas, and assert that its quality can be juggled out of right proportion to its quantity without anyone being the wiser are either ignorant of their subject or wish to mislead.

Some Street Lighting Statistics, by H. Thurston Owens, *American Gas Light Journal*, March 2.

Municipal Lighting at St. Louis, by Charles C. Casey, *Municipal Journal and Engineer*, February 19.

# Foreign Items

## Illumination

The papers of greatest interest dealing with this subject since the previous review have been contributed in the United States. There have, however, been some articles on the subject in Europe and also some comments on American contributions which are of interest.

Dr. Monasch (*Jour. für Gas*, etc., Jan. 25, Feb. 1, 8), discusses the distribution of light from various forms of "portable" lamps, among which he includes electric reading lamps, petroleum kitchen lamps, etc. He gives the distribution curves of the various lamps under consideration. In the case of reading lamps some form of shade is essential because the shape is usually such as to throw a shadow just where the light is required. The common "kitchen" lamp comes in for some deserved criticism. These lamps are usually suspended from the wall with the object of illuminating the whole room. To assist this object a reflector throwing the light out at right angles to the room is provided. The illumination so produced is, however, rarely satisfactory, and the result is that the lamp is often taken off the wall and placed near at hand on the table; for this purpose the reflector is specially ill-adapted, for it throws the light straight into the eyes of the observer instead of downwards onto the table. In reality there is no reason why a kitchen should be worse illuminated than any other room, quite the contrary.

Dr. Monasch also discusses the various methods of rating lamps and their application to this type of lamp. In most cases the candle-power of portable lamps even if measured is taken in a horizontal direction. From one point of view the mean spherical C.P. is an impartial basis of comparison between different lamps, but frequently fails to express the illuminating value of a source under practical conditions. Dr. Monasch winds up by giving a series of curves of horizontal illumination, plotted out from results obtained by experiment, and intimates that this is really the most satisfactory method of comparing results.

The editorial colums of the *Journal of Gaslighting* contain some reference to the supposed difficulty in cooperation experienced between those representing the gas and electrical lighting in the Illuminating Engineering Society. While referring to some recent comments on the subject of gaslighting in The Illuminating Engineer, the journal professes to note signs of friction between the two sections and proceeds to argue the impossibility of cooperation in Great Britain where the competition between gas and electric interests exists in a more pronounced form. That there is in reality very serviceable and satisfactory cooperation between the representatives of both forms of lighting in the United States is sufficiently evident from the recent combined action of the Illuminating Engineering Society, the Institute of Electric Engineers and the Institute of Gas Engineers, in order to discuss the question of standards of light. It is a matter for regret that in some quarters in England there has been a reluctance to recognize the possibilities of cooperation and an apparent desire to magnify the existing difficulties which seems to suggest a very narrow view of the whole subject of illumination.

The *Electrical Review* for February 7, quoting from The Illuminating Engineer, contains some sensible remarks on the subject of the inspection of residence-lighting, stating that, quite apart from any immediate gain in custom to be derived, it is well worth while to do all that is possible to secure the friendly good-will of a consumer, for many such, though only using a relatively small amount of electricity themselves, are very frequently in a position to put the matter before others who are in a position to use more. In fact, it is the old story that a well-disposed consumer is the best advertisement, which is applicable to all methods of lighting.

The correspondence on the measurement of street illuminations still continues. Mr. Trotter and Mr. Roger Smith have expressed their belief in the horizontal screen. Mr. Harrison and Mr. Wild prefer the inclined one. Mr. Mackenzie em-

phasizes the fact that all such measurements are only an indication; what we are very greatly concerned with is the physiological impression of brightness or otherwise that the pedestrian in the street receives. Such an impression is very greatly influenced by the vertical illumination which does not receive justice by the horizontal method. Mr. Wild is impressed by the inaccuracies of street photometry arising very largely from the low order of illumination which has to be measured. He also refers to the possibility of the cosine law not being applicable at the very oblique angles at which the rays in these cases fall upon the photometer screen, and the limit to accuracy set by the possibility of "angle-errors."

## Electric Lighting.

The recent literature on this subject is again mainly concerned with the metallic filament lamps and the effect of their introduction on industrial conditions.

Hirschauer (E. T. Z., Jan. 30), calculates the influence of variations in the supply P.D. on the candle-power of the various existing types of glow lamps. The candle-power of an incandescent lamp is connected with the P.D. across it by the following relation:

(c.p.) = C(P.D.)n, where C. and n. are constants. The most important constant is "n," as this determines the variation in c.p. caused by an alteration in P.D. The author gives the following table of results:

| *Type of lamp.* | *Value of "n."* | *Variation in c.p. corresponding to a change in P.D. of + 25%* |
|---|---|---|
| Nernst | 10. | 50. |
| Carbon | 6.3 | 31.5 |
| Tantalum | 4.3 | 21.5 |
| Osmium | 4.2 | 21. |
| Osran | 4.0 | 20. |
| Just-Wolfram | 4.0 | 20. |

*Electrical Engineering* (Feb. 13), contains a résumé of this article and a previous one on the same subject by Loring (*Elec. World,* Jan. 4).

The situation has also been dealt with in an interesting article by Hobart (*Times* Eng. Supplement, Feb. 5), The author remarks on the drawbacks of applying metallic lamps to high pressure circuits, and even advocates the adoption of a 2,200 volt supply stepped down to 25 volts at the consumer's premises. He also points out the shortsighted policy of the engineer authority, which, fearing a loss of revenue, does not encourage consumers to adopt the most efficient lamps.

This last point is taken up in a long article by a writer in the *Electrical Times.* He, too believes that the new lamps will ultimately prove a benefit to supply authorities, in spite of a temporary loss in revenue. It will be remembered that "A Lamp Maker" (*Elec. Engineer,* Dec. 6), took a somewhat gloomy view of the situation.

O'Hanlon (*Elec. Rev.,* Jan. 3), discusses the design of small transformers for use with metallic filament lamps.

In the *Electrical Engineer* for Feb. 21 appears an abstract of a recent paper by Remane before the Electrotechnische Verein. The author gives a summary of the three chief methods of making Tungsten filaments, the "Paste method of Auer," the Just flushing process, and the Kuzel colloidal method. He also describes more particularly the manufacture of Osran lamps, which are made by the "paste process," and gives the results of tests on these lamps, according to which a life of 1,000 hours is possible without the waste per H.K. having very appreciably altered from the original value of near unity.

Prager Dressler (*Elek. Anz.,* Jan. 30), gives a description of the magnetic arc. This lamp has found its widest application in the United States and is not well known in Germany. He describes the essential construction of the positive copper-slab electrode, the negative magnetite and titanium ore, the rate of burning away in which can be controlled between wide limits. Thus one negative electrode, 200 mm. long and 16 mm. diam. lasts 50-500 hours, according to its composition.

In the case of the carbon arc 85 per cent. of the light comes from the positive electrode, and 10 per cent. from the negative. In the magnetite arc all the light practically comes from the arc itself which is 20-26 mm. in length and usually requires about 70 volts.

The light given by this lamp is very white in character, but the author considers it somewhat unsteady.

The watts per H.K. he gives as about 0.5 to 0.6 (per mean hemispherical intensity).

GAS, OIL AND ACETYLENE LIGHTING.

Under the heading of "An Illuminating Power Test Twice Removed from Modern Conditions" the *Journal of Gaslighting* discusses a recent judgment against an English gas company, in which the use of an obsolete form of burner for gas testing, specified by an act of 1868, was enforced.

It is uncertain at the present time what the future methods of gas-testing adopted will be. Possibly, as some have prophesied, a colorific method of testing will eventually be agreed upon. Meantime measurements on the basis of illuminating power occasionally lead to rather curious situations, such as is presented by the use of a burner designed to meet conditions existing 40 years ago, i.e., more than 20 years before the advent of the incandescent mantle.

Webber (*Gas World*, Feb. 6), insists on the fact that photometrical measurements ought only to serve as a tool and that the conclusions to be drawn from them must be modified by the special circumstances of the case.

In particular, when several different methods of securing a given ground illumination are possible we must apply ourselves to the problem of also producing the most tasteful effect. The author illustrates this point by means of three examples of different arrangements of lights arranged to give the same illumination but differing in their aesthetic results. He also considers that electric lighting has hitherto suffered from the aesthetic point of view through lack of units of exactly the right intensity, and remarks that the infinite gradations in the value of incandescent gas units are advantageous in this respect.

A writer in a recent number of the *Zeitschrift für Beleuchtungswesen* comments on the necessity for some effort at standardization in the matter of inverted incandescent mantles and burners. At present a great variety of such fittings are in use, owing to the narrow view taken by many manufacturers also have constructed their burners in such a way that they can only be used with the one particular type of mantle sold by the same firm. The object of this is to force a consumer who has adopted a certain type of burner to always buy his mantles from the same source.

A similar plan at one time adopted by glow lamp makers was to make the lamps in such a way as only to fit one special holder.

Naturally all such efforts have the effect of disgusting the consumer with that particular form of lighting. The rapid strides of the upright type of mantles were only attained through adherence to uniformity. A recent letter addressed to the various makers of incandescent mantles on the subject elicited favorable support and it is hoped that some agreement on this vital point will soon be reached.

The *Electrical Engineer* (Jan. 31), refers to the case of the Central Library West Ham lighted by gas with, it is said, the result that the bindings of many books were injured by fumes. How far this is the result of bad ventilation is, however, not quite clear, while it also seems uncertain whether the deterioration is to be attributed to the heat from the flame or the chemical action of the fumes produced.

Guiselin (*Journal du Petrole*, Jan. 20), gives the results of some recent tests of oil lamps carried out in accordance with the recommendations of the recent Petroleum Congress. One essential point brought out by these tests is the influence on the efficiency of the lamp of the amount of oil in the reservoir. A lamp containing 700 cc. of oil invariably gave better results than one containing 500 cc.

The consumer is, therefore, recommended to fill his lamp at frequent intervals in order to get the best results.

*Acetylene* for February contains some interesting information as to the application of acetylene to "flare lights." buoys and lighthouses. There is also an account of the system of free inspection of acetylene generators by the French Society of

Acetylene Apparatus Owners. Prizes are offered for the best kept arrangement.

PHOTOMETRY.

No very notable contributions to the literature on this subject have been made since the last review, though several of the articles mentioned therein have been reproduced elsewhere.

The *Electrician* (Feb. 2), contains a résumé of the recent study of plain and frosted lamps by Hyde and Cady (Bul. of the Bureau of Standards). One interesting point raised in this paper is the question of the great reduction candlepower question of glow lamps with frosted bulbs during their life. This seems to be entirely due to the light absorbing deposit formed on the bulb of the lamp, and not any alteration in the structure of the filament.

The new form of "Universal Photometry" of P. S. Millar is discussed in several places, while the recent article in the *Electrotechnische Zeitschrift* dealing with the photometrical laboratory of Messrs. Korting & Matthiesen has been also reproduced.

Houstonn (*Phys. Zeit.*, Feb. 4), discusses a new form of spectrophotometer.

The *Electrician* (Feb. 21), abstracts a recent paper by Merritt on the recoveries of selenium cells after exposure to light. Some curves are given illustrating this recovery which the author finds to closely resemble the peculiarities of certain phosphorescent substances which he has recently been studying.

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# Miscellaneous News

CAMDEN, N. J.—The City Council Lighting Committee recommended that Council accept the proposition of the Public Service Corporation to light the city for a period of six years and a half for $80 per arc lamp per year. This is also to be the rate in any territory which may be annexed to the city during that term. The present contract of $109.50 per lamp per year expires June 30, 1909. The Public Service Corporation proposes to date the new contract as of January 1, 1908. This in itself will be a saving of $27,000 to the city. At the election in the fall of 1906 the voters by a small majority decided in favor of a bond issue to establish a municipal lighting plant, but the referendum on the question showed such a small majority in the affirmative and the total vote in the affirmative being less than one-fifth of the total registered vote, City Council did not consider that this expression of the people's will was mandatory. In view of the much lower rate to be obtained by making a new contract with the Public Service Corporation the alternative of erecting a municipal plant was rejected and a contract for a period of six and a half years approved by the votes of all but three members of City Council.

HARTFORD, CONN.—At the meeting of the Board of Public Works the proposed lighting contract with the Connecticut company was examined. The contract provides for supplying 182 incandescent lights in place of the present Welsbachs and 109 others besides at $20 per light. The lights are to be twenty-five candle-power, and the term is for three years with a privilege of five. The commissioners approved the contract and will submit it to the corporation counsel before a report is sent in to the Common Council.

CHICAGO, ILL.—The council committee on gas, oil and electric light has decided upon the ordinance fixing the price of electric current which the Commonwealth Edison Company shall charge consumers. Several changes were made in the draft of the ordinance and were referred to First Assistant Corporation Counsel Miller and General Counsel William G. Beale, of the Commonwealth Edison Company, for legal phraseology. The changes are:

City shall be entitled to use cross arms of company's poles to carry electric lighting wires as well as for police and fire alarm service.

Right to "convey sounds and signals by means of electricity" withdrawn.

City shall have the right to fix the maximum rate for power as well as light.

City shall have the power to inquire into unjust discrimination between patrons of the company who receive the same class of service.

Ordinance shall become effective August 1.

A provision for publicity of company's accounts was inserted with a provision that it should not operate to make public the trade secrets of the company.

KANSAS CITY, MO.—It is probable that an ordinance to adopt the plan for a uniform lighting system for the business district of the city will be introduced in the Council soon. A committee from the Business Men's League has conferred with the mayor regarding the plan. The system which the League wants adopted provides for lights suspended from ornamental brackets attached to trolley poles. Eight lamps to be placed in a block, four on each side of the street.

LOS ANGELES, CAL.—Tax Collector Johnson has sent notices to business men and residents of the ornamental light zone for the year's lighting bill. It averages about 5 cents per month, per front foot, or 60 cents per foot for the year. The notices for the payment of the assessment for the proposed lighting of Fourth street, from Main to Hill, on the same plan, were also mailed. The system of posts and wiring will cost the property owners $1.75 per front foot.

ST. PAUL, MINN.—"Ornamental Street Lighting for the Business Section" was the subject of discussion at the last meeting of the Minneapolis Publicity Club, held at the Nicollet Hotel. It was agreed that Minneapolis was far behind St. Paul and other cities in respect to illumination in the business district. Papers were read, and an address on the subject by H. J. Gille, W. H. Levings, L. S. Donaldson, R. W. Clark and A. W. Warnock. Mr. Gille, the first speaker, said that light was a medium of publicity and that a city could not have too much of it. He said that it not only aided the merchants, but that it added to the prosperity of the city in general. Light, he held, aided materially in creating a good impression. R. W. Clark spoke of New York's "Great White Way," and the amount of advertising it brought that city. He said it alone attracted thousands of visitors in a night. Mr. Clark, referring to St. Paul's "Ways of Light," said no comment was necessary. Their beauty and the advertising they brought, was sufficient.

JERSEY CITY, N. J.—The Street and Water Board has awarded a five-year electric lighting contract to the Public Service Corporation at $75 per light per year. Under the five-year contract, which recently expired, the price was $97.50. The Board got the Public Service Corporation to grant an additional concession to the effect that when the number of street lights in Jersey City reaches 2,500, the price shall be further cut down to $70, just as is the case in Newark. At present Jersey City has about 1,600 electric street lights.

PITTSFIELD, MASS.—The Board of Aldermen, without a dissenting vote, have adopted an order authorizing the Committee on Fuel and Electric Lights to conduct such investigation as it may deem wise concerning street lighting and its cost in cities of the size of Pittsfield in New England and throughout the country, and to make a new street lighting contract. The present contract with the local company will expire April 1 and the new bids must be submitted by March 16th.

NEW HAVEN, CONN.—Orders have been placed by the United Illuminating Co. of this city with the Westinghouse Electric Co. for a large extension to its electric lighting plant in George street. This improvement will enlarge the incandescent light service in the residential sections of the city.

The enlargement will call for two new steam turbines of 400 horse-power each, with direct connected generators. The generators will constitute two units of the high tension, alternating type, which will give the company about 10,000 additional incandescent lamps of 16 candle-power each.

MORRISTOWN, N. J.—The Morris Township Committee has granted the Morris and Somerset Electric Company a franchise to erect poles and wires and lay conduits for street lighting on the streets and avenues of the township, with certain restrictions. The matter has been held in abeyance for several months as a number of large property owners objected to poles and wires that might injure their shade trees.

PRINCETON, N. J.—At the next meeting of council, a committee of three will be appointed to determine the advisability of a municipal lighting plant for this borough. After going over the ground, the committee will report its findings back to council, when that body will take action on the matter. The question of a municipal lighting plant for the college town was brought before council when Professor A. W. Phillips introduced an ordinance in council relative to the matter. The committee will be appointed by Mayor Robinson.

PROVIDENCE, R. I.—Arthur B. Lisle was chosen general manager of the Narragansett Electric Lighting Company at a meeting of the directors, succeeding in that position Marsden J. Perry, who resigned some days ago.

Mr. Lisle entered the company's employ when it was a small corporation, and for 12 years was actively associated with its affairs, winning promotion from one position to another, until he attained the office of assistant general manager, retiring about three years ago to enter the firm of D. A. Peirce & Co., investment securities.

ST. JOSEPH, MO.—The public is gratified that the investigation of affairs at the municipal lighting plant has disclosed no greater faults than some irregularities that have brought small pecuniary loss to the city and that may be guarded against in the future. It is particularly gratifying that Superintendent Stewart emerges from the unpleasantness with a clean record for honesty. That he trusted others too much is his only shortcoming. Yet men who give themselves up to technical work are not always in position to scrutinize details; they must depend more or less upon subordinates. The report of the investigators shows that the plant is in good condition, that the service is satisfactory and that the cost of operation is reasonable.

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## *Contents of This Issue.*





ILLUMINATING ENGINEERING PUBLISHING COMPANY

E. L. ELLIOTT, Pres. J. B. LIBERMAN, Secy-Treas. E. S. STRUNK, Business Mgr.

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# *Schools — Libraries — Light*

*The art of printing has set a task for the human eye which results in a greater amount of effort and strain than all its labors for other purposes put together. Unfortunately, also, the tendency in those products of the printing press which are most numerous and most used is rather to increase eye strain than to decrease it. Unquestionably the greatest volume of reading done at the present time is of the newspaper press; and its typographical development has tended toward indistinctness rather than clearness. The newspaper of a century ago could be read with less fatigue than the average daily of the present time.*

*The development in the production of artificial light has been, in a general way, along similar lines; that is, it has been cheapened in price, and increased in* QUANTITY, *but the* QUALITY *of the resulting illumination is very often inferior to that obtained from the light-sources of our grandfathers.*

*The library as a public utility for the benefit of the masses is a strictly modern institution. By far its largest use is during the hours when the illumination must be artificial light. There is no single case of public lighting which is of greater importance, nor which should receive more careful study and more liberal treatment at the hands of those responsible for its management. The library building is, in the nature of things, representative of both the civic and artistic spirit of the city or town in which it is located. Its architectural features, therefore, should receive serious and careful consideration; but the mistake should not be made of treating such a building merely as a monument or architectural embellishment. Unless the building is the repository of a worthy collection of books, and provided with a system of lighting by which the books can be read with the greatest facility and comfort possible, it entirely misses its purpose and becomes a mere showroom.*

*What has been said in regard to the public library applies to an even greater extent to the public schools, in so far as they are used for evening work. The eyes of children are, comparatively speaking, as tender and sensitive to overwork and strain as are the muscles of their bodies. Permanent injury to a child is a misfortune to the victim and a crime at the hands of those responsible for it, which is measurable by the years of life during which the affliction must be borne. "Nothing is too good for the children" should be the motto, rather than "Anything is good enough for a child," which has been only too often followed. To require children to do exacting eye work by insufficient or badly directed light is as much of an injustice and cruelty as to compel them to bear burdens or perform physical labor beyond their bodily strength.*

WHEREVER READING OR WRITING IS TO BE DONE, EITHER BY YOUNG OR OLD, LET THE BEST ARTIFICIAL ILLUMINATION WHICH THE MAGNIFICENT MODERN LIGHT-SOURCES HAVE MADE POSSIBLE, BE AT THEIR COMMAND.

E. L. Elliott.

# The Preservation of the Eyesight in Children

By Hubert E. J. Biss, M.A., M.D. (Cantab.), D.P.H.

The Education (Administrative Provisions) Act passed last year enforces on education authorities throughout the country the duty of providing machinery for the medical inspection of elementary school children under their care. The potentialities for good which lie in this measure are great, almost overwhelming —that is, if the Act be administered in a broad and generous spirit. At the moment one cannot but be impressed by the fact that authorities generally, while rendering homage to the principle of the measure, seem to wish to get out of the practical responsibilities imposed upon them at the least possible cost. This is not the place to enter into local politics, but it is obvious that cheap inspection is likely to be perfunctory inspection, or if not perfunctory, at least not highly skilled inspection. If the work is to fall into the hands of callow lads, or bread-and-butter young ladies, fresh from hospital, medical inspection, it is likely to become something very like a failure, both administratively and medically. Sympathetic knowledge of children and seasoned experience of parents are essential attributes for the work, for the inspector has first of all to entice youngsters to disclose their shortcomings, and then to persuade the parents that preventive or remedial measures are necessary.

In nothing will these qualities be more needed than in the discovery of defective eyesight and the teaching of its significance. The amount of ocular mischief in town-bred children is immense, and so little is it recognized that one is apt to be looked upon as a crank, a faddist, or an alarmist, for insisting on the elementary precautions that sense and science alike show to be necessary, if education is not permanently to damage thousands of the youngsters who are now hustled to school by crusty parents and conscientious attendance-officers. Nor is it only the children of the poor that are threatened, and not infrequently engulfed, by these dangers. It is paradoxical, but no less true, that the qualifications for teaching children and the capacity for understanding them are far more diligently inquired into in the case of most elementary school teachers than in that of those who instruct the young sprigs of the "nobility and gentry." A candidate for a mastership in an upper-class school is considered sufficiently accomplished if he has pursued a mute, inglorious career at one of the universities, and his claim is rendered undeniable if he has played cricket in his college eleven and been "tried for the 'Varsity." That these healthy young barbarians, as Matthew Arnold taught us to call them, have no knowledge of teaching may be a matter for regret; that they have no acquaintance with the physiology of the child is something approaching disaster. How can the pedagogue barbarian be expected to think that a wretched little astigmatic, who can only see half of his book at a time, is anything but a "stupid young ass"? Or what wonder is it if he add two or three dioptres to the myopia of all the short-sighted boys in his class by making them gaze at the blackboard in impossible cross-lights, or write out five hundred lines because their nightwork is constantly unsatisfactory? Just in proportion as the eye is of higher educative value than all the other senses, so is it worth the more careful preservation, and if parents and the custodians of the young are not instructed in the dangers of eye-strain and its prevention, their wards are likely to be cut off from the most valuable channel of knowledge.

The eye is endowed with capabilities for conveying information to the brain which makes all other sources pale into insignificance. The extent covered by the field of vision is bounded only by the horizon; the rapidity with which knowledge is conveyed by the eye is as close an approximation to instantaneousness as we are acquainted with in nature; and the variety of qualities such as form, size, color, number, and texture, which it can appreciate in an object, has made the verb "to see"

synonymous with the verb "to comprehend" in every civilized language. Milton deplored the loss of his sight at least as much from the educative as from the social standpoint, for in his address of "Light," after bewailing what his affliction deprived him of in æsthetic joy, he cries,—

> "and for the book of knowledge fair
> Presented with a universal blank
> Of Nature's works, to me expunged and rased,
> *And wisdom at one entrance quite shut out.*"

That that one entrance should by all human effort be preserved is the birthright of every child.

It is only of recent years that it has been possible to obtain definite facts as to the eyesight of the rising generation. The credit of having instituted systematic inquiry belongs to the late London School Board, which in the year 1899 passed a resolution that teachers should be requested to test the eyesight of children by means of certain testing-cards with which they were supplied, and to record the results. The figures obtained were doubtless somewhat crude, as the work was new to the teachers, no checking or supervison by medical men was carried out, and the tests were somewhat hurriedly run through in the foggy month of December. Still, not only as a valuable departure in school hygiene, but as actual demonstrative evidence of the prevalence of eye-defects, the results were little short of epoch-making. To make the figures obtained intelligible to those unacquainted with the usual methods of expressing the results of vision-tests, it may be well to explain that the standard test-type is constructed to be read at a distance of 6 meters. If the examinee cannot read it at that distance he is shown types which a normal eye can read at 9 meters; if he cannot read those, he is taken on successively to such as can ordinarily be read at 12, 18, 24, 36 and 60 meters. The smallest type the examinee can read is taken as the measure of his vision, and the result is expressed in a fraction, the numerator of which states the distance at which he was standing, namely, 6 meters in the usual way, and the denominator, the distance at which the type which he actually read can be read by a normal eye. Thus normal vision is expressed by the fraction $^6/_6$, which signifies that the type which should be read at 6 meters has actually been read at 6 meters. Less good is $^6/_9$, which indicates that the examinee could at 6 meters only read type which should have been read at 9 meters, and so on. In the first examinations under the School Board $^6/_6$ and $^6/_9$ were classified as "good vision"—though $^6/_9$ is already distinctly below par—and $^6/_{12}$ or less as "defective vision."

And now as to results. The number of children examined was 338,920. Of these, 259,523, or 76.6 per cent., were returned as having "good vision," and no less than 79,167, or 23.3 per cent., as having "defective vision." In other words, a quarter of this enormous number of children suffered—unsuspected—from marked eye-defects, and of them 2675 at 6 meters could only see what they should have read at 60 meters, and 230 were unable to read any test type at all! With regard to districts it is interesting to observe that the highest percentage of defects was found in the city, where only 56.6 per cent. of children—barely more than half—had good vision, the other districts below the average being Westminster, Hackney, Tower Hamlets, Finsbury and Southwark. These are all thickly populated neighborhoods, and as bearing out the relationship of congestion to visual deficiency, it is noticeable that in Greenwich, Lambeth, Chelsea and Marylebone, where homes are less densely packed and open spaces more ample and numerous, the eyesight was above the average. These observations lend further illustration to the principle that where small demand is made on the eye for distant vision, the acuity of sight is proportionately less.

Dr. Kerr, who had been in practice as an ophthalmic surgeon, was appointed Medical Officer to the School Board shortly before that body was disintegrated, and was retained in the same capacity, to the great advantage of the London child, by the Education Committee of the London County Council. The work initiated before his advent met with his warm cooperation on taking office, and under his advice the machinery for examination was elaborated and strengthened. Ophthalmic surgeons were appointed to check the results of the teachers' testing, and various further points were brought under investigation. Vision was now classified as "good" when $^6/_6$, "fair" when $^6/_9$ or $^6/_{12}$, and "bad" when $^6/_{18}$ or less. The effect

of defective vision on school progress was examined into, and the effect upon eyesight of crowded and open areas more thoroughly investigated. As the result of the first year's work under the new conditions, five important facts were brought out:—

1. That among children with defective sight the proportion below the average educational standard of their class, at every age from eight years to twelve, is considerably higher than that of those above the standard.

2. That visual acuity increases with each year of school life.

3. That a constant proportion of 10 per cent. of children have "bad" vision throughout school-life.

4. That the greater part of the defective vision is due to slight defects which give imperfect but fair vision, due probably to mental and ocular conditions, and of the greatest importance educationally in the first half of school-life.

5. Finally, that very bad vision ($^6/_{36}$ or worse) is met with in a proportion increasing regularly from 1.5 per cent. in the lowest standard to 3.5 per cent. in the highest.

One paragraph of the report is so important that it deserves quotation verbatim. "School effects," wrote Dr. Kerr, "from fine work and poor illumination are more likely to show themselves in general nerve strain and unhealthy neurotic or nutritional conditions than in very defective visual acuity during school-life. The real harm of defective vision and of school-work not adapted to the visual capacity of the young lies in the strain thrown on the developing nervous system."

Further experience has only served to strengthen these conclusions, and the work of weeding out the visually unfit and instilling scientific notions of what are proper conditions of illumination, and what class of work is adapted for children at various ages, has progressed steadily. The last year for which full returns are available is 1907, and the large number of children examined, over 400,000, the accuracy of the work—all the results being checked by ophthalmic surgeons—and the effect of extended experience as to what constitutes dangerous defect in vision in children, all combine to lend them permanent interest. Of the total examinees, 409,944 in number, the teachers returned 44,139 (10.7 per cent.) as defective for school purposes. This number was reduced on expert examination to 32,149 (7.8 per cent.), and, finally, 28,492 were given cards urging that surgical advice should be sought. A striking fact about these figures is that they include non-provided as well as provided schools, and though the former as a whole contain a rather better class of child, the visual defects were markedly higher in them than in the provided schools. One cannot resist the reflection that the bad hygienic conditions, especially as to the lighting of class-rooms, prevailing in many non-provided schools, may be largely responsible for this disparity. There is not room here to discuss more fully the question of the prevalence and significance of these eye-defects, but, lest it should be thought that the London child is gifted with exceptionally bad vision, it is instructive to note that in the investigations carried out among the school children of Aberdeen and Edinburgh under the auspices of the Royal Commission on Physical Training (Scotland), it was found that in Edinburgh the percentage of normal vision, as fully tested by refraction, was only 45.33, and that in Aberdeen was even less, namely, 43.8! It is not to be presumed that all the defective children these figures connote were in need of immediate treatment; but the Commissioners wrote with regard to those in Aberdeen: "The proportion of children requiring correction by spectacles for errors of refraction was slightly under one-fourth of the whole of the children examined"!

Before turning to the preventive measures necessary to obviate the aggravation of visual defects, attention should be drawn to the fact that in the child the eye normally is shallower from before backward than in the adult. The consequence of this is that the amount of accommodation which in an adult would focus the image of the object looked at on the retina, would in the child still throw it behind that structure, and that therefore a child needs to make a stronger effort at accommodation to achieve the same result as a grown-up person. Another difference is that the lens of a child's eye is normally more convex than in the adult, and therefore, whereas the latter relaxes his accommodation for distant vision, in the child a distinct effort is necessary to accomplish

the same object. Now eye adjustments, especially those for near vision, are muscular actions. The reading of a book involves no less than three distinct efforts, namely, an effort by the muscles attached to the eyeballs to bring the eyes towards the middle line, so that the visual axes may converge on the print; an effort by the ciliary muscle to adjust the lens to an appropriate condition of convexity; and an effort by the circular muscles of the iris to make the pupil contract and shut out divergent rays of light. Now not only have these muscular efforts to be made, but they have to be kept up all the time that reading is going on, and as all muscles weary under strain, and as the strain in the case of the child is greater than in an adult, it is clear that this fatigue is a very real and trying factor. As the eye develops normally the visual acuity increases. It has already been pointed out in Dr. Kerr's figures that the vision in the various standards improves with age. But if by muscular strain the elastic eyeball of the child be unduly dragged upon, any existing defective condition may be greatly increased, and in any case the mental and nervous symptoms produced not only retard educational progress, but actually endanger the general health.

Though these questions may appear to many to be of more or less academic interest, to all associated with children in every class of society, they "palpitate with actuality," as the French have it. No parent, especially if he be a town-dweller, can afford to let his child run the risks involved to health, progress, and eyesight, which negligence of the hygiene of the eye involved. Some of the necessary elementary measures for avoiding eye-strain may be usefully mentioned. First and foremost is the question of illumination, natural and artificial. Lighting should not be too stinted, nor too abundant, nor wrongly directed. In the school-room or nursery the window-area should be at least one-sixth of the floor space, and one-fourth is better. The windows should reach nearly to the ceiling, and should descend so near the floor that the minimum of shadow is obtained beneath them; moreover, they should be placed as close together as structural stability allows, so that there may be no shadow between them. It is far better that light should be admitted on one side only of the room; in the case of the school this should be the left. The end walls should be blank, covered by a pale neutral tinted paper. Top-lights are rightly forbidden by the Education Code. If sufficient illumination cannot be obtained by the windows on the left, light must be admitted from the right, but it must be distinctly understood that such a supply is supplementary, and the amount of window-space strictly limited by actual needs. Nothing is more puzzling to the eyes than a cross-light. To prevent too great an access of light on sunny days, blinds should be provided to cover the whole window area, and they should be made of green holland or other dark material. For artificial illumination electric lighting is best, especially a high candle-power lamp in a frosted globe. One type of lamp is so excellent that out of gratitude I am almost tempted to mention it, but as my subject is scientific and not commercial, I refrain. No doubt there are plenty as good.

Next to illumination comes the question of position. The near point at which a child should work with its eyes is a distance of 12 inches; at any rate, not a fraction under ten. Any child who cannot read, write and sew comfortably at this distance is either possessed of defective vision, or is forming habits fatal to ocular health. The body should be upright, supported in the middle of the back, with the thighs at right angles to the body, and the knees at right angles to the thighs; the feet should rest flat on the floor, and the desk or table should admit of this attitude being easily maintained. To prevent the head drooping the surface containing the work should be adjustable to an angle of from 15 degrees to 20 degrees for writing, and from 30 degrees to 40 degrees for reading. In the case of reading it is most important that no printed books should be given to young children under five, and picture-books should only contain bold objects unembellished with fine detail. School-books are much better than they were, but there is still much room for improvement. Children between nine and twelve years of age should be allowed no print smaller than *Pica*.

(This shows the size of Pica.)

Children below that age should have their books printed in *Double Pica*,

# (This shows the size of Double Pica.)

or *Great Primer*,

## (This shows the size of Great Primer.)

The margins should be wide, the lines and letters well leaded out, and all type used should be fresh and sharply cut.

Writing is the most trying of all exercises, and it should never be long continued. Unlined paper and ink are the materials of choice, and the small ruled squares in which the letters have each to be formed separately should never be permitted. All paper for reading or writing should be unglazed, and the so-called vertical script is worthy of hygienic commendation on account of the lack of temptation it offers to the formation of faulty attitudes. For girls there remains the crucial question of sewing, and it must regretfully be admitted that this admirable domestic art is one beset with danger to the youngster's eye. For girls under five it should be absolutely forbidden. After that age a darning needle and coarse yarn may be used if the yarn is of a dark color, and the material on which it is worked is of a pale shade, or *viçe versa*. But even this modest accomplishment must be carefully supervised, and if the child be found to bring the work close to the eyes, needle and yarn should be put away for a year or two. Fine needles, fine thread and fine work are bad for anybody, and they certainly should not be used by girls till they are in their teens. Perhaps the most pernicious sewing-work is the very useful one of "patching," when the object of the seamstress is to make her repairing work as neat and little obtrusive as possible. It is the veriest tempting of Providence to set children to it.

In view of the well-ascertained dwarfing of visual acuity which town life conduces to, it is hardly necessary to say that the open country is the ideal entourage for a child, more especially such as have known defects of vision. To give the eye free play as far as the horizon, with the minimum amount of near work and the least possible confinement to houses and streets, is the natural and rational method of preserving the eyesight. Apart from the direct benefit produced to the general health of children by bringing them up in the country, the value of rural life in sparing the eyes from undue fatigue, and thus sparing much mental and nervous irritability, is very real indeed, and constitutes not the least of the benefits which a back-to-the-land policy would bring about. I shall hardly be deemed guilty of exaggeration by those in a position to judge if I say that much of the change the national character has undergone during the last century is due to the changed ocular conditions under which children are brought up. It is the duty of everyone at least to see that these conditions operate as little harshly as may be.

# The Origin and Use of Louis XIV Fixtures

By G. W. Pearce.

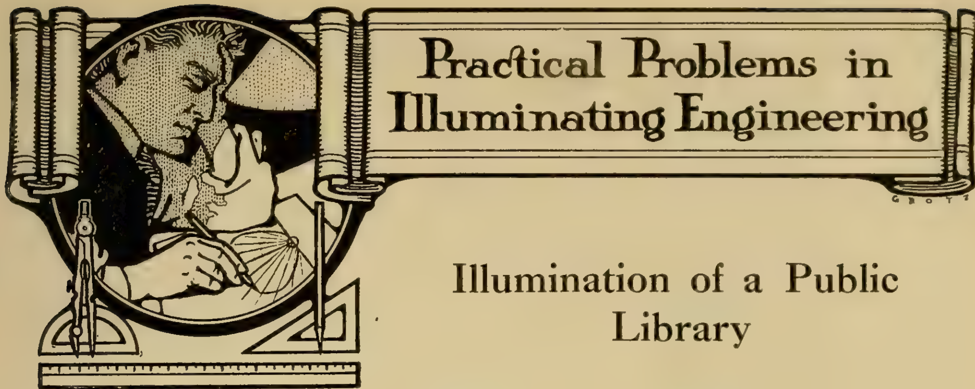
Few in the fixture business at home or abroad know who was the originator of the Louis XIV. school of design in metals. It was Charles Perrault, born at Paris in 1628, died at Versailles in 1703. He designed and modeled all the exquisite lighting fixtures at Versailles and at the King's palaces in Paris. Much of this work is intact, and is the joy of artists.

Many of Perrault's fixtures exhibit cupids and cherubs holding torches, torch extinguishers, and branches of acanthus formed into candle holders and to serve as brackets, sconces, girondoles, newels and chandeliers. A study of the faces of the cupids and cherubs shows them reflecting all the emotions of children. Perrault modeled these faces from his own children and from those of the nobility at the court of the Grand Monarch, Louis XIV. To obtain the emotional effects of joy, mirth, hope, eagerness and other infantile emotions in his models, he invented and told them fairy stories and composed rhymes and little songs which, when published, became the possession of all peoples; they are living in all languages. What did he compose? Here is a partial list: Little Red Riding Hood, The Sleeping Beauty, Patient Griselda, Cinderella or the Glass Slipper, and last, but by no means least, the immortal Mother Goose Melodies.

That gay, swinging, martial and rollicking song, "Malbrouck," was composed by Perrault for the entertainment of some of his models, the children of a great general of the French Army, with whom Perrault had served as an engineer in a campaign against that valorous English general, the Duke of Marlborough, whose name the French then and now pronounce Malbrouck. On a battlefield Perrault had picked up a letter from Sarah, Duchess of Marlborough, to her husband, scolding him for staying in camp in France during a truce, while she pined for him at Dover Castle. Of this incident Perrault made the song which is still sung throughout France, where to this day many a child that is fractious is frightened to bed with the tale that "the terrible Malbrouck is coming."

The present Duchess of Marlborough has an exquisite collection of gold gilt Louis XIV. candelabra made in this country with remarkable fidelity to the expression of the cupids and cherubs portrayed from the French Marshal's children, for whom Perrault composed the stirring words and music of "Malbrouck." Washington was so fond of this French song that he had it arranged for the field instruments of his headquarters band. He delighted in hearing it sung with a thundering chorus by the army of Rochambeau, whose mother had sat as a child to Perrault for one of the cupids with a torch. This fixture was modeled for the grand salon in which, many years afterward, the treaty of peace was signed between the King of Great Britain and the Thirteen Colonies.

The principal architects employed by very rich persons for designing mansions are as busy as at any time within a decade. The depression in business is having no effect on any trade carried on principally to supply the wants of the rich. There are now on the draughting boards of the higher classes of architects plans for upward of 200 mansions, none of which will cost less than $500,000—exclusive of land and furnishings. Most of these mansions will require gold gilt fixtures in profusion. With a few exceptions, the fixtures will be in the styles of Louis XIV., XV., and XVI. One estimate, almost ready for submission to fixture makers for Louis XIV. fixtures, calls for an expenditure of not less than $35,000. The architects limit the competition to four fixture makers, which number, in their opinion, is the list of strictly first-class makers in America. Doubtless under present conditions our reputable fixture makers are making the very finest lighting fixtures in the world.




## Illumination of a Public Library

The problem in the present case is typical in many ways of the conditions with which the illuminating engineer has to deal. The plans for the building had been completed, the structural work nearly finished, the lighting system laid out, and the electric wiring nearly completed, when the services of the illuminating engineer were called in. The floors had not been laid, which afforded opportunity for additional wiring at comparatively small cost and trouble.

The installation throughout the building, as originally planned, consisted of lamps studded in the ceiling, either in rows symmetrical with the ceiling as a whole, or with the panels, as the case might be—a method, as most will agree, that has about as many faults for use in such a building as any that could be well devised.

The method of treating the problem will be sufficiently indicated by the following extracts from the report made by the illuminating engineer to the authorities who had the general supervision of the building.

GENERAL CONDITIONS.

Building consists of a central rectangular portion nearly square with rectangular wings adjoining symmetrically on each side, and is two stories high with full story basement. Central portion contains corridors, book stacks, and various executive rooms. The wings are used for reading, reference and assembly rooms.

A complete lighting system has been laid out and the installation is practically complete with the exception of the lamps and fixtures. Electricity is the light source to be used, gas being provided at a few points for emergency use. The present installation provided for the use of no single units over 16 c.p.

The installation as laid out will provide an ample quantity of light for the purposes intended. The objects of the modifications suggested are two:

(1). To improve the quality of illumination in certain of the rooms, and

(2). To reduce the general cost of maintenance.

*Hallways.* A general illumination free from glare and of moderate intensity is most desirable for this purpose. Calculations should be made for a minimum of one-half foot-candle of intensity of illumination on the floor. The present arrangement of 16 c.p. lamps set into sockets in the ceiling will give ample intensity but with considerably less economy than by other means. I would suggest the use of one 12-inch Holophane hemisphere with Pagoda prismatic reflector and a 50 c.p. high-efficiency lamp for each panel of the ceiling. This will produce a very softly diffused light and an illumination of practically perfect uniformity and of sufficient intensity. This method is applicable to the first and second floors only.

On the third floor there is no opportunity to place such lighting fixtures. By the use, however, of prismatic reflectors over the lamps as provided, 8 c.p. lamps could be substituted for 16 c.p. On this floor the centers of the panels are furnished with a stained glass skylight. While this will be effective during the daytime, it will be entirely dead at night. By placing a single 40 c.p. lamp in a prismatic reflector in the attic above each of these stained glass skylights they could be illuminated at night, and add greatly to the artistic effect.

THIRD FLOOR CORRIDOR. 4 C.P. FROSTED LAMPS AND PRISMATIC REFLECTORS AROUND THE DOMES. 16 C.P. CLEAR LAMPS ON THE ARCHES.

A comparison of the cost of lighting by the method as laid out and by the method suggested is given in the following table:

| | Present system. | | | Proposed system. | | | | |
|---|---|---|---|---|---|---|---|---|
| Floor. | Number lamps. | Watts each. | Total watts. | Number lamps. | Watts each. | Total watts. | Watts saved. | Saved per hour. |
| Basement. | 36 | 56 | 2,016 | 6 | 125 | 750 | 1,266 | .06 |
| First..... | 152 | 56 | 8,512 | 8 | 125 | 1,000 | 7,512 | .37 |
| Second.... | 152 | 56 | 8,512 | 152 | 28 | 4,256 | 4,256 | .21 |
| Total saving per hour.................. | | | | | | | | .64 |

Cost of current figured at 5 cents per kw. hour.

Unless shades or diffusing globes are used on the ceiling lamps, it will be necessary to use frosted lamps in order to avoid intolerable glare. Frosted lamps reduce the quantity of light given out by 12 per cent, and shorten the useful life of a lamp by 30 to 40 per cent. It is therefore more economical to use some form of diffusing globe than to diffuse the light by frosting the lamp itself.

*Assembly and Reading Rooms.* These are rooms 40 x 60 feet, with ceilings 10, 12½ and 14 feet high, in the basement, first, and second floors, respectively, and occupy the wings of the building. They receive daylight from windows on three sides. The illumination provided is by means of 16 c.p. lamps set into the ceiling, and arranged in a geometrical manner. This method of illumination is open to serious objections for rooms to be used for either of these purposes. As before mentioned, unshaded lights at a high angle are particularly fatiguing to the eyes, a defect which is aggravated in this case by the large number of lamps so placed.

In the assembly room in the basement it will be impossible for any one occupying a seat in any part of the room to avoid the glare of a row of lights placed in the annoying position.

In the rooms to be used for reading and

CHILDREN'S READING ROOM, 40 FT. WIDE, 60 FT. LONG, 12 FT. CEILING. FORTY 4 C.P. FROSTED LAMPS AND THREE HOLOPHANE BOWLS WITH 187 WATT GEM LAMPS IN EACH PANEL.

reference rooms provision is made for table lights, a method which affords the only satisfactory illumination for reading. Aside from the reading light thus afforded, only a mild general illumination is required, in which softness and freedom from glare should be particularly sought. Such an illumination can be most economically and effectively secured by using a comparatively small number of lamps in diffusing bowls placed on or near the ceiling. In the basement rooms these will preferably be arranged by placing three symmetrically in each panel. The use of 50 c.p. high-efficiency lamps and 12-inch Holophane hemispheres with reflectors will give a general illumination in the room at the height of a table, of more than one foot-candle, which will be ample for the purpose.

The same arrangement may be used for reading and reference rooms on the first floor; or an arrangement of eight 50 c.p. lamps in Holophane hemispheres, arranged as shown in the diagram on sheet 5 may be used. At three feet above the floor, or at the height of a book held for reading, the minimum illumination will be one foot-candle, which is as strong as necessary or desirable in view of the special reading light furnished from the table lamps.

The two rooms on the second floor are at present supplied with eighty sockets distributed about the edge of the coves of the ceiling. These offer the additional objection of giving the greatest illumination about the sides of the room, where it is probably least required. As the ceilings in these rooms are fourteen feet high, it would be advisable to drop the hemispheres three feet from the ceiling in order to secure the most economical results, although this is not an absolutely necessary arrangement.

The relative quantities of current used and the saving secured will be as follows:

Present system: Eighty-four lamps, 56 watts each, 4704 watts.

Proposed system: Nine lamps 125 watts each, 1225 watts.

Total saved, 3479 watts.

NEWSPAPER AND MAGAZINE ROOM, 40 FT. WIDE, 60 FT. LONG, 14 FT. CEILING. EIGHTY 4 C.P. FROSTED LAMPS IN THE BORDER, EIGHT HOLOPHANE BOWLS WITH 187 WATT GEM LAMPS.

GENERAL REFERENCE ROOM, 40 FT. WIDE, 60 FT. LONG, 12 FT. CEILING. FORTY 4 C.P. FROSTED LAMPS AND THREE HOLOPHANE BOWLS WITH 187 WATT GEM LAMPS IN EACH PANEL.

MEDICAL AND DENTAL LIBRARY ROOM, 40 FT. WIDE BY 60 FT. LONG, 10 FT. CEILING. TWENTY EIGHT 4 C.P. FROSTED LAMPS AND THREE HOLOPHANE BOWLS WITH 125 WATT GEM LAMPS IN EACH PANEL.

Saving, per hour, 17 cents for each room.

The total saving of current in the six rooms would be practically $1 per hour, figured at 5 cents per k.w. hour. If this arrangement is used, it would be well to fill all the sockets at present provided with eight candle power frosted lamps, which could be used if desired on special occasions.

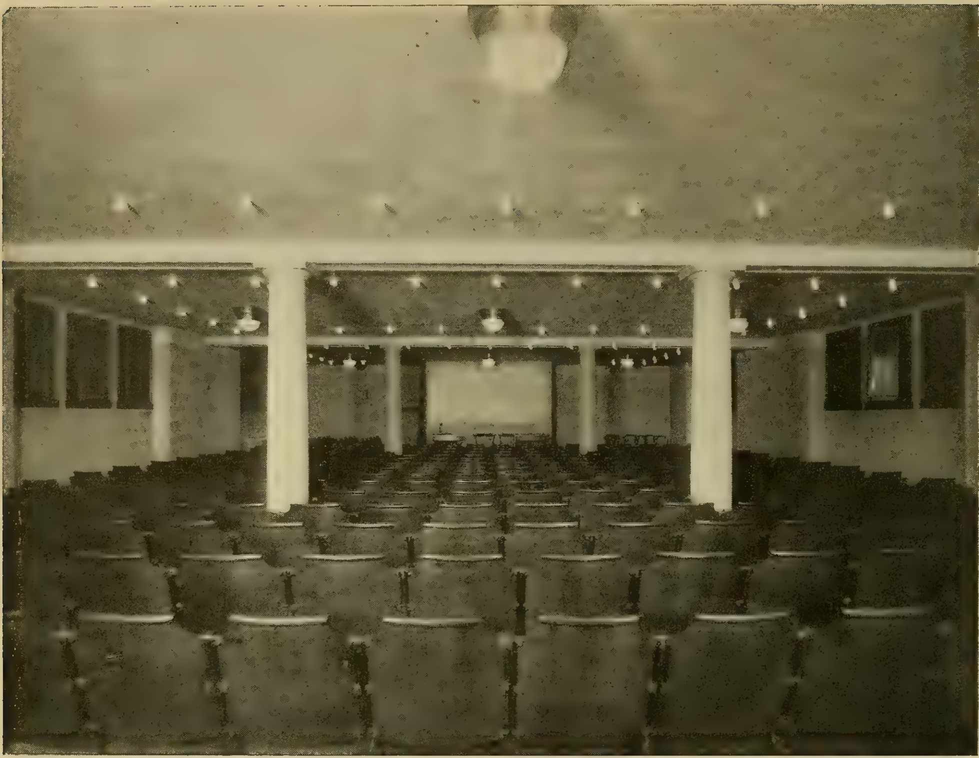
Two reading lamps should be provided for each table and be fitted with a green opal shade having a white lining. It would also improve the reading light to have the tip end of the lamp frosted in order to remove the streaks and spots of light that the bare lamp produces. This special frosting absorbs little light and therefore reduces the efficiency by only a small amount.

*Book Stacks.* The most economical method of furnishing a thoroughly satisfactory illumination for the stack room is to provide a general illumination of the two aisles, which can be done by the use of three 16 c.p. lamps with prismatic reflectors in each aisle, placed against the ceiling. On the first floor a 50 c.p. lamp with Holophane hemisphere and reflector should be used over the main stairway, back of the delivery desk.

For lighting the alcoves either of the following methods will be found satisfactory:

(1). Two 16 c.p. lamps with Pagoda reflector No. 2672 attached to the centers of the crossbeams supporting the ceiling, as shown in Fig. 1, sheet 6. This arrangement will give ample intensity of illumination on the bottom row of books; and provided the lower rows of books are always kept well out to the edge of the shelf, would be entirely satisfactory; but if books were pushed back, the title would fall in the shadow of the shelf above.

(2). This difficulty would be entirely overcome by the use of four 8 c.p. lamps with Pagoda No. 2623 placed at the upper corners and inclined toward the opposite lower corner, as shown in Fig. 2, sheet 6.



AUDITORIUM, 40 FT. WIDE, 60 FT. LONG, 10 FT. CEILING. TWENTY-EIGHT 4 C.P. FROSTED LAMPS AND THREE HOLOPHANE BOWLS WITH 125 WATT GEM LAMPS IN EACH PANEL.

This latter method would give as nearly perfect illumination for the purpose as is possible to obtain.

A switch should be provided at the end of each stack to control the lamps in that alcove. An attendant will therefore be able to light up the particular alcove in which he wishes to find a book without lighting any other alcove.

There are two small square rooms on each floor which will be used for various purposes. A single 50 c.p. high-efficiency lamp in a 12-inch Holophane hemisphere with reflector will furnish a very satisfactory general illumination. In the other room, used for cataloguing, board meetings, children's assembly room, and other purposes, each being supplied with two outlets symmetrically placed in the ceiling, it would be well to use a 75 c.p. high-efficiency lamp in a 14-inch Holophane hemisphere with prismatic reflector.

In the work rooms, etc., where the appearance is not of importance, high-efficiency lamps with reflectors alone may be used with more economical results and less first cost.

It is safe to say that the illumination by the means suggested would represent a saving of $1.50 per hour for the whole building, based upon current at 5 cents per k.w. hour, and assuming that lamps of ordinary efficiency, that is, 3½ watts per candle, would be otherwise used. By using high efficiency 16 c.p. lamps, that is, 3.1 watt per candle, this saving would be somewhat reduced, but would even then amount to more than $1 per hour, which is an item of expense well worthy of consideration, and which will justify some increase in the first cost of installation.

The means suggested, however, consisting of high-efficiency incandescent lamps and Holophane globes and reflectors, will probably be no more expensive than the usual arrangement of chandeliers, as an economy of metal work is effected, and at the same time the objectionable features of metal chandeliers, namely, deterioration by collection of dust, corrosion, etc., are avoided. Owing to the

FIRST FLOOR CORRIDOR, 11 FT. WIDE, 85 FT LONG. HOLOPHANE BOWLS WITH 125 WATT GEM LAMPS.

comparatively low ceilings any form of chandelier dropped down into the range of vision would, in the writer's opinion, be highly objectionable from the artistic standpoint.

Such gas jets as need be provided for any emergency use should preferably be on inconspicuous side brackets.

After submitting the report, the writer had no opportunity or occasion to follow the matter until some three years after the building was completed and used. Inquiry as to whether the suggestions made had been carried out and whether the results were satisfactory elicited the information that the directions had practically all been carried out, with the one exception that the table lamps had not been provided in the reading rooms, and that the general illumination was evidently entirely satisfactory, as no complaints had been heard from any source. This proof of the quality of the results is certainly of a negative nature, to say the least, and much less convincing to the illuminating engineer than it appears to be to the librarian and to the patrons of the library. The average American is an uncomplaining mortal, especially in regard to those utilities which are provided at public expense, and a system of lighting which would actually be so bad as to call forth expressions of public disapproval would be something worth going miles to see.

The statement that the table or reading lamps had been omitted was also made without any apparent appreciation of what this omission means. It is pretty nearly equivalent to the familiar allusion to the play of Hamlet "with Hamlet left out." The matter, however, is not difficult to explain. It will be observed that the changes suggested were by way of additional light units to take the place of the individual ceiling lamps which had already been provided for, and the actual installation of which was a necessity from a merely decorative standpoint. As a result, there were two lighting systems available for use in all of the rooms, and by the use of both systems together, a general illumination of sufficient intensity

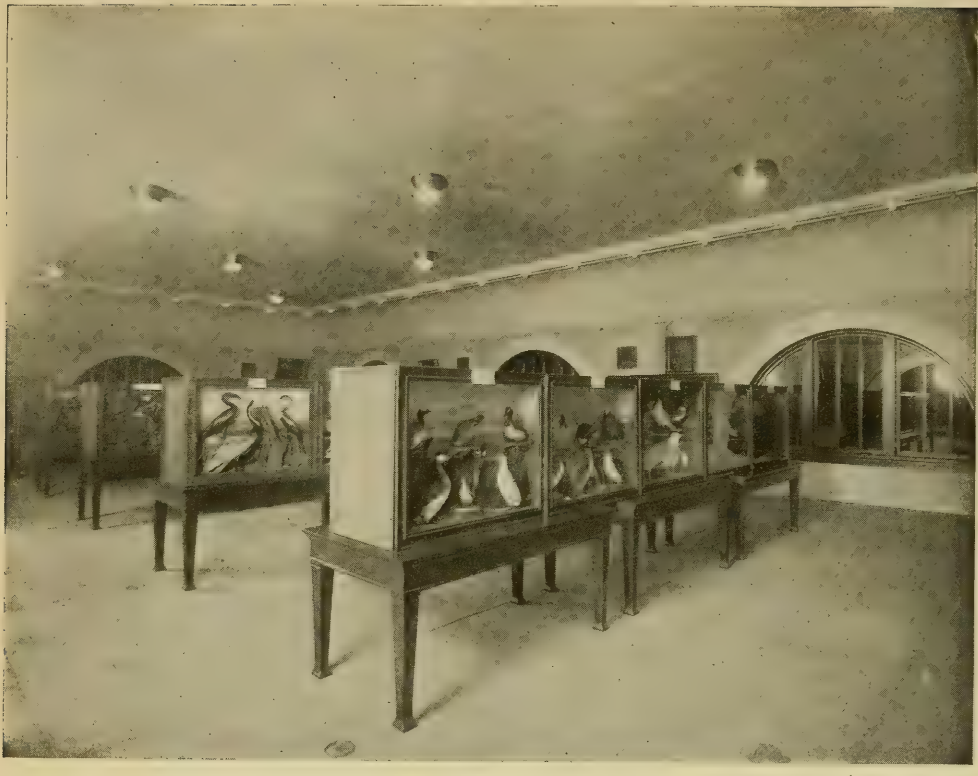


EXHIBIT ROOM, 40 FT. WIDE, 60 FT. LONG, 14 FT. CEILING. EIGHTY 4 C.P. FROSTED LAMPS AROUND THE BORDER, EIGHT HOLOPHANE BOWLS WITH 187 WATT GEM LAMPS AND PRISMATIC REFLECTORS.

for reading could be readily produced. "What's the use of putting in more lamps; it's light enough to see to read anywhere in the room now?" is the way we can fancy the average director or trustee sizing up the situation.

However, in the language of the poets, we may "thank the Lord things ain't no worse." The ceiling lamps are frosted and of low candle power, and therefore the combined systems have as few objections as could well be secured with any system of direct ceiling lighting. Furthermore, the arrangement of the circuits is such that the total quantity of light can be varied through almost all degrees from zero to maximum. The economies which were shown in the recommendations, which were undoubtedly one of the most attractive features of the report, have probably not been realized in practice, for the reason that, both systems being available, there is a natural tendency to put them into simultaneous use. In the rooms not used as reading rooms, however, the improvement in the illumination by the addition of the ceiling bowls is a positive advantage, as the arrangement of the studded lights around the ceiling near the walls would have resulted in a very unequal distribution, with the darkest portion in the center of the room, where it should be the lightest.

Such is the history of this particular case of illuminating engineering. Whether or not it was successful will depend upon the observer's point of view, and we therefore, leave it for the reader to judge.

# Studies of Notable Installations

## Bates Hall—Boston Public Library

Perhaps no single room has been more criticized in regard to its artificial lighting than the large reading room in the Boston Public Library, designated as Bates Hall. A photograph of this room is reproduced on the front cover of this issue. The principal library building in the Athens of America, and the hub of the universe, would naturally be looked up to as a model of architecture that should be an example to all nations. In its general architectural design, as well as in the character of its mural and other decorations, the building is, indeed, one in which not only Bostonians but all Americans may feel a just degree of pride.

The lighting of a building of this character, therefore, involves a consideration of that most seriously disputed question, illuminating engineering versus architecture. Perhaps no more complete illustration of the two different viewpoints could be found than the room in question. A glance at the illustration will show that, while the strictly utilitarian purpose of the room has not been overlooked, the architectural effect has been carefully studied and worked out with a high degree of artistic skill. There is little attempt at decoration, the structural features themselves being depended upon for the general effect. The masonry construction is freely shown in the treatment of both side walls and ceiling, both of which are of a neutral gray tone, which has unfortunately been considerably deepened by the accumulation of soot—a reminiscence of the coal strike of several years ago.

The lighting scheme consists of table lamps provided with the usual green and white opal reflectors, and clusters of incandescent lamps supported on standards placed immediately in front of the pilasters. As will be seen in the illustration, the standards support a large frosted glass globe surrounded with incandescent lamps with frosted bulbs, at the height of the top of the bookcases. The entire general illumination of the room depends upon the light from these standards.

Considered from the strictly engineering point of view, there is no occasion for severe criticism. The arrangement of the table lamps is the one usually recommended by illuminating engineers for such purposes, and leaves little to be desired in the way of a practical and satisfactory illumination for reading and writing. The single objection to the arrangement is that if the tables are fully occupied so that the readers must sit squarely facing the tables, there will be more or less direct reflection from the book or paper, due to the light being in front instead of at the side. A suggestion for remedying this common fault will be found in the discussion of library lighting elsewhere in this issue. So far as the actual intensity is concerned, the general illumination afforded by the standards is ample. The lighting of the bookcases might be better, but is by no means hopelessly bad. The location of the side light, in a position about on the level of the eye of a person standing, would doubtless be severely criticised by many, as presenting a number of light-sources almost directly in the line of vision; but as the sources are fairly well screened by

diffusing globes, the fault, if such it be, is reduced to a minimum. On the whole, therefore, there is no reason why those using the room at night for its allotted purpose should not be able to do so with as much comfort and convenience as can well be expected.

To the stranger within its walls, however, bent only upon studying the architectural features of the building, the effect of the lighting would be quite a different matter. The entire upper portion of the room, and particularly the vaulted ceiling, is left in comparative gloom, more suggestive of Faust in his study than of a student in a modern public library. It may be remarked here that no matter how well lighted the lower portion of a room may be, if the ceiling is conspicuously darker the general effect will be cheerless and gloomy, while, on the other hand, a light ceiling gives an air of cheerfulness and welcome. So far as the actual use of the room is concerned, at night, the upper portion could be entirely dispensed with, and the ceiling placed a few feet above the bookcases.

From the artistic viewpoint, the general lighting system is unequivocally bad. To this conclusion the illuminating engineer will readily subscribe. But how to make it better? It is easier to criticise than to mend. Four possible methods suggest themselves: chandeliers dropped from the centers of the arches; lamps set in the rosettes in the ceiling panels; brackets placed much higher up on the pilasters; and indirect lighting from lamps placed at the back of the cornice.

The chandelier method would at once be rejected on account of the interference with the perspective, which is the chief feature of architectural beauty of the room.

Brackets placed on the pilasters, at about the level of the window sills, or possibly a little higher, would be preferable to the method now used. The difficulty of this method, however, would be the same; that is, of insufficient light on the ceiling. This might be overcome in a measure by the use of some of the modern high-candle-power, high-efficiency lamps, with opal shades, which would thoroughly diffuse the direct light, and reflect a considerable portion upward.

Individual lamps, set in the rosettes of the ceiling, should prove very satisfactory, so far as illumination is concerned; the only objection would be the mechanical difficulties of reaching the lamps for renewal. This might have been provided for in the beginning by arranging for their insertion from the top or outside of the arch. This method would give the necessary illumination on the ceiling and in the upper portion of the room and also give the rosettes a reason for existence, which is entirely lacking under the present arrangement. The rosette would furnish, both in fact and in appearance, a reflector and holder for the lamp. The light, emanating from the panel, would also fulfill the esthetic requirement that, since light suggests a void, it should never emanate from, or be most intense on, the supporting parts of a structure. Frosted lamps should, of course, be used.

Indirect lighting, from cornice light, would have been particularly practical and effective in this case, and undoubtedly offers the only feasible method of correcting the original error, under existing conditions. In this case, the ceiling should be given a very light tint.

## A Typical Reading Room in a Boston Branch Library

The above illustration shows a reading room of the type common among the Boston branch libraries. The lighting furnishes a most impressive example of the short step from the sublime to the ridiculous, metaphorically speaking; or, technically, from what is passably good to what is terrifically bad. So far as dollars-and-cents economy is concerned, there is little room for improvement in the arrangement shown. The total volume of light provided is ample, and the intensity on the tables and book shelves likewise sufficient for the purpose. It is perfectly evident, however, that it would be impossible to sit in any position in the room without having at least four incandescent gas mantles, with their exceedingly intense glare, shining straight into the eyes.

A comparison of this reading room with the one described above very naturally suggests the query, "If carefully shaded individual lamps are necessary in the general library building, why are they not equally necessary in the reading room of the humblest branch library?" Library buildings may differ, but the human eye

is pretty much the same in the tenement-dweller and in the inhabitant of Commonwealth Avenue. But to pursue this line of discussion might lead us on to dangerous ground; we will therefore return to our mutton.

The simple addition of an eye-cup or bobêche, costing some 10 cents, to each of the mantle burners, would remove the most serious fault of the lighting in this case and, in fact, give a general result that could scarcely be improved upon as a method of general illumination; and there be those among the craft of Illuminating Engineers who maintain that general illumination is better than special illumination for reading rooms, drafting rooms, and the like. At any rate, the improvement that would be effected by the method suggested, if so great, and the outlay involved and the trouble required to make the change so small, that it should appeal to even the most cautious of library directors.

It is hardly conceivable that electric current is not available in the libraries of which the present one is an example, although it is quite possible that the building was not wired for electric light when it was constructed. The use of gas is most probably, therefore, a concession to economy.

The use of table lamps, when gas is the only available luminant, would hardly be considered practical, with the regular type of upright incandescent gas burner; there would be too great liability to breakage of the mantle by vibration and accidental jarring of the burner. With inverted burners, however, there is no reason why the use of table lamps should not be quite feasible. Such burners are being successfully used for lighting railway coaches, and if they will stand the vibration and jar incident to such use, they should certainly be capable of fulfilling the requirements of the library table. So far as the resulting illumination is concerned, it would be in every respect quite the equal of that from electric lamps.

# Theory and Technology

## Plain Talks on Illuminating Engineering

By E. L. Elliott.

### XV. Schools and Libraries.

The importance of good illumination in the case of schools and libraries is not to be measured on a merely dollars-and-cents basis. The alarming extent of defective eyesight in school children has attracted the attention of both the medical and educational authorities all over the world. The causes of this rapidly increasing danger may be properly classed as follows, given in the order of their importance:

1. Over-strain resulting from prematurely subjecting the eyes of the young to reading fine print and other details.
2. The prevalence of bad illumination, both artificial and daylight, in the home.
3. Bad lighting in school rooms.

For the first of these causes the parents must be held chiefly accountable, although the selection of books and the arrangement of the courses of instruction have an important bearing on the subject.

The eyes of infants and children are no more suited to the continuous strain occasioned by keeping them focused on fine details near at hand, as in the case of reading, than are the fingers to perform steady painstaking work. Muscle, brain, and nerves acquire their ability both to perform and to endure labor by a long process of development. While this development may be facilitated by careful and proper direction, any attempt at forcing is sure to lead to ultimate defects. We are rapidly becoming a race of spectacle wearers; and while spectacles are a valuable invention in themselves, their use is always more or less of a handicap. There is no work which cannot be performed better and with greater comfort without them.

Bad lighting in the home is an evil which is as prevalent as it is inexcusable. Modern light-sources, with their intense brilliancy and enormous flux of light, are commonly pointed to as triumphs of modern science; and considered only by themselves, so indeed they are; but like other scientific devices, they must be used with due precaution. Attention has not infrequently been called to the fact that in the days of our grandfathers, when the tallow candle was the most commonly used light-source, and the small kerosene lamp was considered a magnificent luminary, almost nothing was heard of defective eyesight. To wear glasses was considered an affliction to the young, and one of the necessary disabilities of old age.

Increase in defective eyesight has kept pace with the increase in efficiency in methods of producing light. What is the explanation? It can hardly be put down to mere coincidence; there is a closer relationship between the conditions. The discovery of this relationship is the first essential to abating the evil. The cheapening of light has vastly increased its use. Our grandfathers were as careful about blowing out a candle the instant its light could be dispensed with, of seeing that two candles were not burning when one would answer the purpose, as we are today in turning out an electric lamp; and with good reason, for light was a luxury.

The item for candles, sperm oil, or "burning fluid," was no small matter among the household expenses.

That the use or misuse of artificial light is largely accountable for defective eyesight seems to be established by the fact that in all cases where comparative tests have been made, it has been found that the percentage of defective vision is much larger in the city than in the country.

It is not an uncommon practice for those who have observed the fact without studying the causes to put the blame upon the electric light. Considerable publicity was given to a paper recently presented before the Illuminating Engineering Society, in which the electric light was charged with being the chief offender in this respect. On the other hand a distinguished medical authority in England, writing upon the subject—whose article appears elsewhere in this issue—states without reservation and with considerable apparent enthusiasm, that the electric light is the best possible light for the school room. The simple truth of the matter is that the fault cannot be charged to any particular one of the improved light-sources, considered only as producers of light. The trouble is wholly due to a misuse of these intrinsically valuable improvements. It was long ago said of fire that it was a good servant, but a bad master, and the same may be said of any of the forces of nature, including electricity and light itself. The electric current generated by a few battery cells, which was the only practical source fifty years ago, could be handled with absolute impunity, but the currents from modern generators are quite a different matter, and must be handled with precaution commensurate with their danger; and the same general comparison may be made between the use of the candle and the modern electric light. The injuries that have resulted from the use of the electric light arise from the general neglect of the public to appreciate the difference between the old and the new light, and the precautions necessary in using the latter.

A brilliantly lighted room, which can very easily and cheaply be obtained at the present time with either gas or electric light, furnishes in itself a temptation to turn night into day in the matter of labor and recreation. There is unquestionably a large amount of studying and reading done by children at night that should be confined to the hours of daylight. In fact, in the case of young children, night study should be prohibited altogether. The source of danger to the eyesight at the present time is the use of electric lamps or mantle gas burners, without a diffusing globe or a shade reflector. This is the statement of a fact that has been made repeatedly, but it cannot be impressed too strongly nor too often upon the public. An unshaded light-source of this character is always and everywhere a positive abuse to the eyes, which must sooner or later result in injury and is a practice for which there is no possible excuse. The light from either of these sources, when properly diffused, can be made as hygienic as that from the much praised oil lamp or candle. It is a sad fact, however, that there is a shocking disregard of this simple precaution in the home.

The starting point for reform in the abuse of the eyes of school children is in the home; and those in charge of public schools may consider the advisability of at least calling public attention to this fact, and might very properly lend aid to the dissemination of practical advice and instruction along this line. A child with defective eyes is in reality a cripple—although the defect is not so apparent to others as in the case of a crippled limb. If a quarter or more of the children were to be seen walking with a limp, there would be a general exclamation of horror on the part of the public at this alarming condition, but the fact that fully this proportion see with a limp has just begun to attract attention.

In the case of children it is not sufficient that the best possible illumination be provided; they must be taught to use this illumination in the right way. The first and most important rule for them to follow is never to sit facing the light. This applies to a window, as well as to artificial light. Such a position involves two serious faults: First, the light itself can shine directly into the eyes; and second, it will generally strike the surface of the book and paper at such an angle as to give direct reflection, causing a blurring of the print and a tiresome glare. The correct position is with the light either at the side or from the rear. A light over either shoulder is excellent for reading, but for writing the source must be at the

left side and slightly in front, in order not to have the shadow of the pen or pencil in the way.

There are three general methods by which a school room may be artificially lighted; first, by the usual method of chandeliers; second, by so-called indirect lighting, that is, by reflection from the ceiling; and third, individual lamps for each desk. Of these three methods, the first is the cheapest to install and maintain, but least satisfactory in results. In cases where the light is required only for emergency use, as on particularly dark days, or other special occasions, the chandelier method is admissible, provided always that the lamps, whether gas or electric, are furnished with globes or shades that thoroughly diffuse the light. The use of bare electric or mantle burner lamps in a school room should no more be tolerated than the use of benches without backs, or any other relic of barbarism.

Theoretically, the ideal lighting arrangement is an individual lamp for each desk; but unfortunately there are very serious practical objections, the chief of which is what the scientist would call the personal equation of the pupil, which contains so many unknown quantities that it is impossible to gauge the result by calculation. If there is any place on earth where a thing needs to be fool-proof, it is in a school room, and an adjustable desk lamp, whether gas or electric, has entirely too many possibilities for "accidents," intentional or otherwise, to make its adoption, at least in public schools, feasible.

By the process of elimination, we therefore are forced to admit that indirect lighting offers the best solution of the problem under present conditions.

Much attention has been given, especially within the past year, to indirect illumination, and this method has been officially endorsed for school room lighting by the German authorities. Notwithstand- this apparently authoritative endorsement, however, the method is still open to some doubt as to its hygienic properties. In the article of Dr. Biss, already referred to, he states positively that the top light should be avoided; and the experience of those who have had occasion to work under sky-lights corroborates this view. Furthermore, the fact that it is exceedingly trying on the eyes to read out of doors, especially during the middle of the day, is a further proof of the same contention. Lastly, the report of the German scientists on the subject is wholly academic, being based simply upon the fact that by this means the common defects of glare are entirely removed.

One of the advantages of the indirect lighting system which will especially appeal to school authorities, who know by experience how hard it is to persuade those who hold the purse strings to expend money for improvements in school buildings, is the comparative cheapness with which the ordinary chandelier method can be converted to the use of indirect lighting. Such a change involves merely the replacing of the chandeliers with comparatively simple and inexpensive fixtures, examples of which have been given in previous issues of THE ILLUMINATING ENGINEER. Such fixtures, with lamps to provide the proper volume of light, and used beneath a white ceiling, will generally afford a satisfactory illumination of this kind. In some cases, however, it may be necessary to install more fixtures than were originally provided, in order to obtain the best results. It is needless to remark that the ceiling must be *kept* white, as even a slight blackening very seriously reduces the amount of reflected light. The method is adaptable to either electric or gas lamps, inverted burners being used for gas. With the use of gas, however, it is best to provide metal plates on the ceiling, which can be more readily cleaned.

The color of the walls of school rooms is a matter which should be taken into consideration as affecting the illumination. All darker colors may be at once rejected as unsuitable on all acounts. The gray, drab or neutral tints are also objectionable, both from the fact that they are poor reflectors, and also that they are not what may be termed "cheerful" colors. For the ceiling there is scarcely any color to be considered except white, and for side walls some shade of yellow, preferably a light cream color, best fulfills all conditions. Such a tint is, next to white, the best reflector of light, is satisfactory from the decorative and esthetic viewpoint, and exceedingly pleasant to the eyes.

Blackboards which are commonly located at the front of the schoolroom should be lighted with a trough reflector, or other similar arrangement, exactly as a picture would be illuminated; the re-

flectors being placed above and slightly forward of the board, to that there will be no direct reflection from the board to the eyes of the pupils.

The lighting of public libraries involves three rather distinct problems; namely, the reading-rooms, book-stacks, and rooms used for assembly or for general purposes. As library buildings, at least since the beginning of what we may term the Carnegie period, partake more or less of the nature of architectural models, the esthetic or decorative side of the subject assumes more than its usual importance. While illuminating engineers differ in regard to other problems, there is practical unanimity of opinion, both among engineers and librarians, as to the best method of lighting a reading room, and that is either by light-sources so placed that each individual reader will have a separate light, or a single light-source in the shape of a table lamp, so arranged that several readers will be supplied from a single source. The familiar green and white opal shade so frequently used cannot be excelled, provided a frosted electric lamp is used with it. The frosting of the lamp is absolutely essential in order to prevent the light and dark streaks made by the direct reflection from the filament, as shown in the investigation reported in the February issue. The mild general illumination required may be supplied by indirect lighting, or from shaded lamps.

There is some difference of opinion, however, among engineers as to the intensity of general illumination required in cases of this kind. Some contend that there should not be a great contrast between the special illumination provided by the individual lamps and the general illumination of the room, on the theory that if, when the eye is turned away from the book, as it is more or less frequently, it meets comparative darkness, it will have to readjust the iris; which will produce discomfort. This contention, while very plausible from the purely theoretical standpoint, seems to receive very little substantiation from experience. Except for the necessity of having sufficient light in a room to see to move about in comfortably, there would be no necessity for any general illumination at all. As a matter of fact, in reading the eye is held in focus for the printed matter at the distance at which it is held. This focusing requires an effort, and is therefore in the nature of a strain. The instant the eye turns from the printed page this effort is released, and the focusing muscles relax, and this condition of relaxation and rest is precisely the best possible for eye comfort.

In providing individual reading lamps, there is one simple precaution that is often overlooked. Such lamps are frequently so placed that the readers will naturally or necessarily place a book directly in front of the light-source, with the result that there will be direct reflection from the page. The ideal conditions for reading are fulfilled when the table is comparatively narrow, and divided by low vertical partitions, giving sufficient room for individual readers, say three feet, with a shaded lamp at the forward left-hand corner of each division. Such an arrangement has many advantages. It gives the best possible light if a book is placed upon the table; prevents crowding, and gives each reader a space which he can use for note-taking, and can indicate its occupancy during his temporary absence to the catalogue or delivery desk.

The lighting of book-stacks is a peculiar problem, but one not difficult of solution. The common method of using a lamp on the ceiling between the shelves gives an exceedingly unequal distribution on the backs of the books from top to bottom. The method sometimes used to avoid this defect, of using a trough reflector or similar arrangement, and treating the front of the book shelves as a picture, has one defect which is serious, and that is that if the books are pushed slightly back from the front of the shelves, as they commonly are in use, the shadow of the shelf along the lower part of the racks may entirely cover the titles, making it almost impossible to read them. This defect can be avoided by lighting the shelves on either side by lamps placed on the opposite sides of the alcove. By using a reflector giving the proper distribution, which can be determined by a little calculation, the illumination on the plane of the backs of the books can be made practically uniform.

# Some Physiological Effects of Light

By J. S. Dow.

The many problems connected with the influence of light on the mind and body naturally involve the attention of the physiologist rather than that of the illuminating engineer. There are, however, many cases in which the results of such physiological study bear more or less directly on problems of illumination, and the whole subject is so interesting that the writer may, perhaps, be permitted to refer to some of the many aspects of the question on which the physiologist and the medical man can give useful counsel.

It seems to be now recognized that light plays a more important part in promoting our general physical well-being than might be supposed by one not in touch with physiological study. One comes to associate lack of light with gloom, and there is good reason to suppose that one's natural repugnance to gloomy surroundings may be connected with some physiological effect. It has been stated by the medical profession that light affects to some extent our temperature, respiration, and pulse, and that very probably certain varieties of radiation play a useful part in assisting the oxygenation of the blood.

From this point of view alone there seems good reason to advocate the study of the effect of different varieties of light, especially when it is borne in mind how different is the nature of the invisible radiation from different sources, even when the *visible* spectrum appears to be very much the same.

On one point there can be no doubt, namely, the strong effect of ultra-violet or chemical rays on the body. One would be rash, perhaps, to conclude that these rays are necessarily injurious. They occur in sunshine, the natural light to which our eyes have gradually been accustomed and developed. In many respects an excess of such rays may undoubtedly lead to very serious results.

These rays are very active in producing chemical action, and it is therefore not surprising to find that they have a strong influence on many pigments, and that this action is shown by the sunburning which occurs in tropical climates or even under ordinary conditions, following long exposure to the sun's rays. This effect is to be ascribed to the ultra violet rays only and can be produced easily enough by strong sources of ultra violet light, such as the new Küch mercury lamp. An exposure of the skin for only a few seconds to the light from this lamp produces a darkening which lasts for several weeks.

The rays can, however, also destroy coloration. In Germany it was at one time found necessary by the manufacturers of carpets and other dyed fabrics in the northern regions to send their goods south in order that the permanency of the colors might be tested in districts which were more liberally treated in the matter of sunshine. Now it is thought that this will be unnecessary, because the permanency of the colors can be tested by the aid of the mercury lamp in a mere fraction of the time that is necessary when sunshine is used. One would naturally suppose, therefore, that ultra violet energy in excess might influence the pigment of the hair. As a matter of fact, the author has been assured by a gentleman who was engaged in a large photographic works where much work was done by the aid of naked arc lamps that it was well known that the hair of workers constantly at work under the light from the arc did tend to turn gray; his own hair was very thin and light in color.

It is, however, on the eye itself that the effect of ultra violet rays seems to be most serious. Numberless cases have been recorded in which serious inflammation of the eyes has been caused by incautious exposure to the rays of a naked arc. In some of the worst of these an arc has been utilized to drill a sheet of iron. One can easily understand how the results under these conditions *would* be severe, because the spectrum of incandescent iron vapor is very rich in ultra violet light. For this reason arc lights specially intended for medical purposes have been designed having an iron core. Their richness in ultra violet energy renders their action on the skin specially vigorous, and their curative action in the case of skin diseases is correspondingly enhanced. Yet,

although the injurious effect of excess of ultra violet light is undoubtedly bad, it may again be repeated that we cannot say yet with certainty but that a small dose may not be actually beneficial in some manner, may, for instance, assist the healthy action of the skin or affect the condition of the blood. Therefore, in the present state of our knowledge it seems unwise to advocate the total suppression of these rays by the use of absorbing glasses.

Dr. Seabrook has recently pointed out that the activity of light in producing chemical action increases uniformly throughout the spectrum, becoming more marked as the wave length decreases. This seems to be generally accepted, but it is rather singular that the sensitiveness of the eye to light—*i. e.,* as regards the impression of *brightness*—follows a different law, being most pronounced in the central region of the spectrum.

One explanation which has been advanced to explain this fact is that the action on the retina giving rise to the sensation of light consists of two distinct effects. There is, firstly, a chemical action taking place under the action of light on the small bag of pigment-substance believed to exist at the base of each cone in the eye, and secondly, a tendency on the part of the cone to withdraw itself away from this pigment cell. Both these effects are greatest at the violet end of the spectrum and least at the red end. The effect of withdrawal of the cone, however, is to lessen the ability of the chemical action to produce physiological effect with the result that the total effect is greatest at the centre of the spectrum, where both actions are moderate in intensity.

The question of the intensity of the physiological effect of the different portions of the visible spectrum on the eye is one on which very great difference of opinion, indeed ,seems to exist. According to the above view it would be supposed that the red end was least effective in producing chemical effect, and that the tendency to "exhaust" the pigment substance and tire the eye (if, indeed, the "strain" of the eye as generally understood is connected with the exhaustion of this pigment, as is often assumed), becomes more and more pronounced as the wave length becomes shorter, until the very short ultra violet rays give rise to the severe effects previously referred to.

In spite of this view, there is a very general impression that red light is most trying, because it is in some way stimulating to the eye. Dr. Steinmetz has expressed himself in favor of this view, and has suggested, further, that this greater stimulation is connected with the amount of energy falling on the eye. In the case of most artificial illuminants it happens that energy curve is a maximum outside in the infra red region, with the result that the amount of energy radiated in the red portion is much greater than that at the blue end of the spectrum.

The value of all such discussions is somewhat lessened by the present lack of clearness in specifying exactly what is meant by a "tiring" or "straining" on the eyes. Naturally the effect of too weak illumination, or lights improperly placed, is to strain the eyes, merely because the reader finds it a constant effort to keep his attention on what he is doing and a constant trouble to make out the letters on the page. But whether there is sufficient difference in the physiological action of different rays in the spectrum to cause any appreciable difference in the general influence of different illuminants on the eye, or to cause serious eye troubles, could only be decided definitely by very exhaustive tests. Certainly one would hesitate to express any very definite opinion at the present juncture.

The effect of ultra violet rays has, of course, been proved beyond dispute.

It will be readily conceded, too, that the effect of very excessive amounts of heat rays may be undesirable, and one knows that the results of bringing one's eyes very close to any heated illuminant. Yet here, again, one is inclined to suppose that there need be no difficulty in placing ordinary illuminants so as to render any such effect negligible, and, indeed, such experiments as have been made on the subject suggest that this is the case.

But with regard to the visible rays it is still less certain whether any serious difference in physiological action on the part of practical illuminants can be said to exist, while even the exact nature of the effect of monochromatic light in different regions of the spectrum calls for much closer study before any very definite assertions can be made. It may, however, be pointed out that if uses for monochromatic light in great quantity be

discovered, as has occurred in the case of ultra violet light, and powerful sources of monochromatic light ever come to be developed, the matter may be of vastly greater importance than at present.

The question of the so-called stimulating action of red light and the corresponding depressing effect of blue light does seem to rest on a well-established physiological basis, and may possibly be of influence in illumination. It seems, however, that the rays are supposed to act directly upon the nervous centres, and that the effect is entirely distinct from the action upon the retina referred to above.

Many instances have occurred in which some such effect as that referred to has been apparently found to exist. It was on one occasion found that the workmen in a certain photographic works in France, who carried out their work under red light, were found to become very excited while doing so; but this was no longer the case when glass of some other color was substituted for red.

In the same way small-pox patients confined in rooms screened with red curtains have been found to become delirious, suffering from hallucinations, etc., which, however, disappeared when the red color was removed.

One of the most interesting instances of this effect is the treatment of lunatics by confining them under red or blue light. Maniacs are supposed to benefit by being exposed to soothing blue light; their state is that of over-excitement. Those suffering from melancholia, on the other hand, are said to benefit from exposure to red light, which has a stimulating effect. But perhaps one of the most curious cases of all, in which this effect is said to have been utilized, is that of quieting recalcitrant political prisoners, whose brains are inconveniently alert. See "Light Energy," by M. E. Cleaves.) The author states that such prisoners have been confined under blue light for long periods, so that at first merely soothing effect of blue light becomes eventually deadening to the mental faculties, their brains become permanently stupefied, and they are rendered more or less incapable of dealing with serious intellectual problems.

All these cases, many of them apparently well authenticated, suggest that some such action of the visible extremities of the spectrum does actually occur, and some recent researches of medical science seem to confirm this suggestion. For instance, it has been found that concentrating blue light on the skin has the effect of producing local anaesthea. Again Dr. Radard, of Geneva, is said to have found that the exposure of the eyes of patients to strong blue light is very effective in dentistry in producing a state of insensibility to pain.

It might, therefore, be supposed, though, of course, one would prefer to rely on definite medical assurance before insisting on the suggestion, that certain colors do in some way actually exert an influence on our nerves, and that our method of describing certain shades of color as "warm" or "cold," respectively, is not merely grounded on fancy. One may even hazard the suggestion that the general preference for light having a yellow tinge for indoor illumination is not merely a whim, and not even the result of mental associations.

Mr. Moore, in speaking of the white light from the Moore tube, recently explained how the very earliest forms of light-producing apparatus, the camp-fire and the torch, were very red in color. These sources were followed by the candle and the paraffin lamp, which were still yellowish in tinge, and approximately white light did not arrive until the carbon arc. People, therefore, had become accustomed to illuminants having a somewhat yellow color, and disliked the introduction of the "ghostly" white arc lamp. Apart from this, it has also been suggested that the mind has gradually come to associate the red end of the spectrum with warmth and comfort, as exemplified by the color of the coal fire and the brazier contrasted with the blue twilight without. Therefore, we naturally tend to prefer a reddish light for internal illumination merely because we connect this color with festive occasions and comfort generally.

But as there seems real grounds for believing the physiological effects previously mentioned to exist we can see that a somewhat different explanation of this preference for the red end of the spectrum for indoor lighting seems conceivable. It seems possible that we may incline to the yellowish hues in order to produce a "cosy" and "warm" effect, because there is actually something exhilarating in these

colors, which renders them specially serviceable for festive occasions.

All these are questions which merit discussion. To some they may appear visionary; yet it must be admitted that no general mental effect which induces people to prefer certain conditions of illumination is entirely unworthy of study.

At the same time we must bear in mind the possibility that certain physiological effects are really exercised by certain varieties of light, and, though slight, have a certain cumulative influence worth consideration when it is remembered how we are tending to work under artificial light for much longer periods than in the past. Many slight physiological effects may influence us continuously without our being aware of them; it is only when some very severe instance of their power is brought to our notice that we admit their existence. It may also happen that the effect is slow and cumulative, as in the case of the X-rays, and only makes its appearance very gradually.

Finally, there is always the possibility that, as in the case of the ultra violet light, we may find ourselves able to produce very powerful monochromatic sources of light, and that the invention of such sources may reveal new and unsuspected uses for radiation of this nature

# Rudiments of Illuminating Engineering

By Alfred A. Wohlaüer.

The illuminating engineer, this young off-spring of the old engineering family, enjoys the privilege of having at his disposal the experience of his older brothers, the architect, physicist, electrical engineer, etc. On this account he may combine part of the knowledge of each and thus be to a certain extent more versatile; he is, however, in danger of making the wrong use of an experience which is only inherited and superficially acquired. It would be a mistake, for instance, if the illuminating engineer should, on account of the undeveloped outline of his duties, devote himself to too many things at one time. He should not try to be an architect, nor should the architect endeavor to replace the illuminating engineer. On the other hand, the illuminating engineer would be hardly successful if he were to develop only the theoretical, scientific or mathematical side of his talent.

Of course, it is to be expected that one illuminating engineer is more theoretical, another more practical, and a third more artistic; all three may be equally important, useful, and justified. However, nobody can tell at the present time what course will prove most successful for the illuminating engineer; this the future must decide. But foresight and insight are necessary so that he shall not deviate too much from the right path. Nobody gains experience by simply making use of the wisdom of others, but every one has to struggle against a number of difficulties until he feels himself at home on his own territory.

It seems very likely at the present time that the illuminating engineer who cooperates with the architect will be most successful, with the additional advantage that the artistic principles of illuminating engineering can be developed. The engineering side of the art should not be neglected, however, and mathematical principles should not be left out of consideration, particularly as they, above all, lack proper development. It is the duty of any engineer to combine theory with practice. This means he must utilize theoretical and empirical rules in his mathematical calculations, as well as adapt his mathematical formulæ to the requirements of his practical experience.

While for the development of the artistic side, the illuminating engineer may fall back on the architect, it requires an engineer to build up the engineering fundamentals of the art, and while the average illuminating engineer may not be supposed to develop mathematical formulæ, he certainly will be obliged to intelligently use his mathematical tools. And it is necessary to find simple methods and rules for his calculations, so that mathematical

operations will take the least possible time of his engineering work and not impair his intuition in designing illumination.

That a good deal of hard grinding has yet to be done, in that direction, occurred to the writer when he tried to solve problems of illuminating engineering; the method of determining the values of illumination by use of complicated formulæ, tables, charts, etc., is by no means simple and adequate at the present time, and can consistently be compared with the clumsy procedure of the young scholar when he uses his fingers in order to work himself through the simplest problems of mathematics.

Although we cannot imagine that it will be possible to bring forth permanent relief immediately, the following discussion is a step in that direction and may be considered as an overture for further developments.

It has been recognized by a number of illuminating engineers, here and abroad, that the calculations of the average intensity of illumination are mainly complicated because the polar curves of the various lamps do not obey any law whatever, but are as a rule the accidental result of the construction and the special features of the individual lamp. It has therefore been tried to systematize the polar curves of the lamps by approximately replacing them with curves the mathematical characteristics of which are well known.

Reference need only be made to discussions of Dr. L. Bloch* and of E. W. Weinbeer,† which clearly show the endeavor to simplify the calculations. Everybody will admit, however, that even this way is not a very simple task to determine the intensity of illumination at the various points of a plane.

While the above authors have systematized the polar curves, the writer considers it more promising to take the illumination curves themselves into consideration, approximating them by straight lines. This has been attempted in several recent articles of the writer in the *Electrical World*,‡ where the problem of "Uniform Illumination of Horizontal Planes," important in itself, was discussed.

The shape of polar curves which correspond to straight illumination curves has been determined, and it has been shown that it is very reasonable to expect that such shapes of polar curves can be realized in practice, or that the inaccuracy, involved by using straight illumination curves, can very easily be eliminated.

Such a straight illumination line, however, entails also the advantage of a very simple method of calculating the intensity of illumination at the various points of a plane: it is only necessary to determine the intensity of illumination just below the lamp and a very simple mathematical operation will be sufficient to determine the intensity of illumination of any point of the plane. In Fig. (1) BC represents the illumination curve produced by a certain lamp; CA the intensity of illumination just below the lamp and DE the ilumination at the point D.

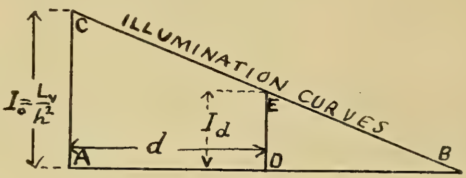



FIG. 1.

If we denote

Lv = the candle power of the lamp vertically downwards.

h = distances from the lamp to surface.

d = distances from the lamp to point D.

$Io = \frac{Lv}{h^2}$ the illumination just below the lamp.

K = a constant of the polar curve, mostly = 1.

Then it can be easily derived from Fig. (1) that

$$I^d = Io \left(1 - \frac{d}{Kh}\right). \qquad (1).$$

If, for example, h = 10 ft., d = 5 ft., K = 1, Lv = 100 candles; then Io = 1, and, according to the above equation, $I^d = .5$.

Still more apparent is the advantage of such straight illumination curves for the calculation of the uniform illumination of large horizontal planes. It is not only very simple to calculate the intensity of illumination but also to figure out the number of lamps required.

* *Grundzüge der Beleuchtungstechnik*, 1907.
† *Elektrotechnischer Anzeiger*, 1907.
‡ *Electrical World*, Dec. 21, 1907, and March 21, 1908.

The intensity of uniform illumination is equal to the intensity of illumination Io which a single lamp suspended at so-called "minimum height of suspension"* produces at a point of the plane just underneath the lamp: if H equals minimum height of suspension,

Lv = candle power of the lamp vertically downward.

Io = the intensity of uniform illumination, then

$$Io = \frac{Lv}{H^2} \qquad (2)$$

and

$$H = \sqrt{\frac{Lv}{Io}} \qquad (3).$$

The minimum height of suspension, furthermore, may be considered the criterion for the distance D between the lamps. For, with a given shape of a polar curve, the factor $K = \frac{D}{H}$, necessitates that

$$D = K \times \sqrt{\frac{Lv}{Io}} \qquad (4).$$

This D is the maximum distance that can be allowed, in order to obtain the desired uniform illumination Io, as can easily be understood and shall be discussed in a future article. It is, however, possible, as pointed out in the article, *Electrical World*, March 21, 1908, to increase the height of suspension above minimum, without impairing the intensity and uniformity of illumination if D and the shape of the polar curve remain unchanged.

Having so determined the (maximum) distance between two lamps it is an easy matter to find the necessary number of lamps:

If T is the length and W the width of the room to be illuminated we can assume that the number of lamps is $\frac{T}{D} = n$ in one direction and $\frac{W}{D} = m$ in the other direction, the total number of lamps N = m $\times$ n, and in the case of a square room, sides of which have the length S, the number of lamps in each direction is $\frac{S}{D}$, the total number, $N = \frac{S^2}{D^2}$.

If we denote the contents of the plane to be illuminated, as $F = S^2 = T \times W$, then the total number of lamps is

$$N = \frac{K^2 \times Lv}{F \times Io} \qquad (5).$$

As the number of lamps has to be an integer, the above quotients, $\frac{T}{D}$, $\frac{W}{D}$, and $\frac{S}{D}$ should be also integers without any remainder. If this is actually the case, S, T, and W being multiples of D, then the distance between the wall and the nearest row of lamps is ½ D and either the reflection from walls and ceilings has to take care of the illumination of this space or its illumination is of no account, as, for instance, if the working plane is not extended to the very walls of the room.

If the above quotients are not divisible without a remainder, however, it is left to the judgment of the engineer to decide whether to choose the next higher or the next smaller number of lamps, or to change the intensity of illumination.

As an example, let us suppose a school room of T = 30 ft. length and W = 24 ft. Width should be illuminated and lamps of a mean spherical candle power of thirty candles are available; let us assume, furthermore, that by the use of the proper reflector, the shape of the polar curve is such that the corresponding illumination curve is a straight line, the factor K = 1 and the candle power of the lamp unit measured vertically downwards is Lv = 200 candles (conditions which can be very well realized in practice); one may proceed then in the following way:

The intensity of illumination is, as a rule, dictated by experience or individual taste; in our particular case of a school room, an intensity of four-foot candles is considered to be sufficient. From the equation (5) the number of lamps can be determined as N = 20, and from equation (4) the distance D = 6 ft. As the length T and the width W of the room are multiples of this D = 6 ft., we find that the number of lamps is four in one direction and five in the other, and the distance between walls and outside rows of the lamps will be three feet, as illustrated in Fig. 2. This space of three feet along the walls of the room is of no account in our particular case of a school-

* See *Electrical World*, March 21, 1908.

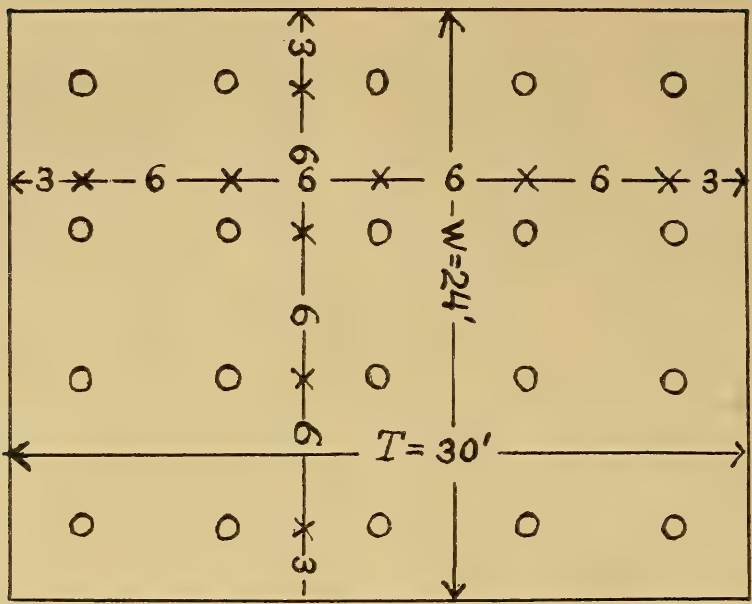



Fig. 2.

room and does not need to receive the full intensity of uniform illumination; it is, however, probable that due to the white painting as customary in schoolrooms the light reflection from the walls will materially add to even up also the illumination of this space.

This example shows how simple it is to go through all the calculations necessary for the design of the illumination in a case like the above. One does not need to reflect upon the polar curve if its character has once been determined, nor is one obliged to apply tables, charts or the like.

It must be stated, however, that the above formulæ should be considered only preliminary and not final, serving only the purpose to show what possibilities arise if the proper attention is given to the engineering side of our art.

# On the Efficiency of the Most Common Sources of Light

By Dr. H. Lux.

As is well known, only a relatively small fraction of the energy expended in the production of artificial illumination is actually converted into light, the greater part being converted into invisible rays, principally of great wave-length, and usually, though incorrectly, termed "heat rays." The rays of very short wave-length, the ultra-violet rays, which also occur, play but an inferior part quantitatively, and may therefore usually be disregarded.

Since, in the production of artificial light, the occurrence of invisible rays of great wave-length is equivalent to waste of energy, it is naturally of great importance in lighting technics to determine the ratio of the visible to the invisible rays. The figures given by various authorities for this ratio, however, differ very essentially, this being due principally to the different methods of research. In most experiments the total radiation of energy by the various sources of light has been determined, and the ratio of the light-giving radiation to the total radiation calculated from the Angström mechanical equivalent of the unit of light

and the average spherical luminous intensity. In proceeding according to this method it has been assumed that the equivalent of the light-unit determined by Angström with a Hefner lamp is a constant physical quantity, somewhat in the same manner as the mechanical equivalent of the heat-unit. The values for the ratio of the light-giving radiation to the total radiation calculated in this manner, however, differ so greatly from the values obtained in various other ways, that the results of the several experiments can scarcely be compared with each other. The greatest differences are those between the values obtained by Prof. Wedding and the values arrived at with the aid of Angström's equivalent.

For this reason I determined to test systematically the most important of the sources of light at present in use, and to ascertain both the total radiation and the light giving radiation by absolute measurement. The radiant energy was measured by means of a Lummer-Kurlbaum bolometer, which enables even the smallest amounts of radiated energy to be detected and measured absolutely. I give seven different methods—three of them original—which, generally speaking, all yield the like good results. In each case the altered bolometer-resistance due to rays being cast upon the bolometer is compared with the like alteration of resistance of the bolometer brought about by a measurable electric current. The measurement of the total radiation, *i. e.,* the radiated energy of all wave-lengths, presents no difficulty.

The difficulties presented are necessarily greater, however, when it is a matter of determining the quantity of radiated energy within the range of the visible part of the spectrum, *i. e.,* of the radiated light. This arises, firstly, from the fact the amounts of radiated energy are extremely small—amounting to only one-millionth of a watt in any given direction of radiation; and, secondly, from the fact that it is extremely difficult, physically, to separate the visible radiation from the total radiation in the same manner as it done physiologically by the eye. I discovered, eventually, that a concentrated solution of ferro-ammonium sulphate in a layer 10 cms. thick yields the best results. This method, at any rate, gives results for the Hefner lamp and the acetylene flame coinciding almost exactly with the results obtained by Angström in an entirely different manner. Thus, Angström found the equivalent for the total light-giving radiation of the Hefner lamp in space to be 0.102 watt, whilst I have arrived at the value of 0.108 watt. In view of the difference in the conditions of experiment this may be regarded as almost perfect agreement. It can, therefore, be assumed that the equivalent of total radiation and light-giving radiation ascertained by me for the various other sources of light are reliable as respect serial order.

It will suffice here merely to tabulate the results of my experiments.*

As is seen from the table, the various sources of light are divided into four main groups, which differ very distinctly from each other. The first group includes those luminous sources which have an exposed flame. The least economical of these are the sources in which finely divided carbon is brought to a state of incandescence.

But in the case of the incandescent gas-light, also, the efficiency is exceedingly low, since the energy supplied is chiefly utilized to bring the nitrogen of the air to a higher temperature, so that more than two-thirds of the energy expended is absolutely lost as far as illumination is concerned.

The employment of the heating-effect for the production of light is a very circuitous method, even when the electric current is used for heating the illuminating bodies. But with the aid of the electric current it is, at all events, possible—even though at present only theoretically—to improve the ratio of light-giving radiation to the energy expended very considerably by simply increasing the temperature. With the employment of flames—however hot—on the contrary, there is no real improvement possible, even if radiating bodies were to be used which radiate still more selectively than the Welsbach incandescent mantle.

An opinion can be formed respecting the fact, if the values for the energy expended shown in the above table are compared with the total radiation measured. The values ascertained for the luminous sources of the first and second classes, that is, for sources with open flames and

*A full report of my investigations will be found in the *Zeitschrift für Beleuchtungswesen,* 1907, No. 16 *et seq.*

the various electric incandescent lamps, are especially instructive. It will be seen that with the sources with open flame only a minute fraction of the energy expended is converted into radiant energy. A substantial elevation of the temperature would, it is true, bring the maximum of radiation into the visible range, but even in the most favorable case, only about 20 per cent of the energy supplied could be converted into light. It is far simpler to attain more economical production of light by the employment of the Joule heat. As the values of the energy supplied and total amount radiated in the case of the electric incandescent lamps make clear, a very considerable portion of the energy expended is obtained again in a radiant form.

In the case of the Tantalum and Osram lamps the losses are only apparently greater than in the case of the carbon filament and the Nernst lamps; the amount of the radiation absorbed by the glass globes used with the metallic filament lamps could not be estimated. In reality these lamps do not behave essentially differently from the carbon filament lamp, where about 15.5 per cent of the total radiation is absorbed by the glass globe, *i. e.*, about three-fourths of the energy expended is converted into radiant energy. An increase in the temperature of the illuminating body would alter nothing here, except that the radiation would be of another *quality*. It might enable the total radiation to consist chiefly of luminous rays, and not, as at present, mainly invisible energy. In this manner the yield of light could be increased to about 60 per cent and more. The great improvement in economy, which is rendered possible by raising the temperature, is shown by the performances of the metallic filament lamps, the greater efficiency of which, as compared with the carbon filament lamp, is mainly due to the higher temperature of the incandescent metallic filament. This is shown still more clearly by the well-known experiment of overrunning a carbon filament lamp.

The problem which remains to be solved, therefore, is to find a material which can withstand continuously a temperature that the present carbon filament lamp can only bear for a few seconds. For the solution of this problem metallic filaments, even of the most refractory metals, would appear unsuitable, since their melting points must set a limit. It would seem that only a carbon filament could withstand the necessary high temperature permanently. Naturally such a carbon filament would have to be absolutely homogeneous, in order to avoid the disintegrating action following the liberation of occluded gases.

In any case, it is more difficult to bring the economy of the pure temperature-radiators to a higher stage, on account of the essentially circuitous method, than to obtain light-vibrations from the electrons by direct excitation. In the case of those sources of light in which the luminosity is not pure temperature-radiation, but is, to a very great extent, the result of luminescence, we approach the solution of the problem. Among luminous sources of this class may be mentioned firstly, the mercury vapor lamp, and, secondly, electric arc lamps, especially those in which incandescent gases of metallic vapors are intentionally brought to a state of luminosity. The enclosed arc and the alternating small current arc, it is true, are at present less efficient than the metallic filament incandescent lamp, so that attempts to attain success by these means do not appear encouraging.

On the other hand, the ordinary direct current arc lamp and, in particular, the mercury vapor Heræus Quartz lamp are more efficient. From the above table we see the degree of efficiency of these sources of light—even today where we are just at the commencement of their development—is very high. Compared with the economy of the ordinary petroleum lamp, which is still by far the most universally used illuminating apparatus, an arc lamp with yellow-flame-carbon is an immense advance. The efficiency of the former is but 0.25 per cent.; while that of the latter is as much as 13 per cent—that is to say, 52 times as much! It is remarkable that with the present means at our disposal, it is possible, even now, to bring the economy of light-production almost to the same level as occurs in the conversion of one form of energy into another, in the steam engine.

*Ceteris paribus,* therefore, those sources of light must be held to be the most advantageous which do not depend mainly upon

pure temperature radiation, until recently the only method at our disposal. From this point of view those values in the above table, which afford information respecting the mechanical equivalent of light for the various luminous sources, are of special interest.

The assumption sometimes met with in the literature of the subject—that the mechanical equivalent of the light-unit must be a constant quantity for all sources of light—would, in view of the present investigations, appear to be no longer tenable. It is also obvious that the value of the mechanical equivalent of light must depend upon the spectral composition of a source, and the differences in the effective values of various sources, even belonging to the same category, can, perhaps, be explained in this way.

But another remarkable fact is brought out by the figures in the last column of the above table. The sources of light—in which finely-divided carbon is rendered incandescent, and also the electric glow-lamps, have an energy-equivalent for the average spherical light-unit which is approximately equal to 0.1 watt H. K. These are the pure temperature-radiators. In the case of the electric arc lamps, on the contrary, we find values which average about 0.04 watt H. K.; and in the case of the mercury vapor lamp, yielding a pure line-spectrum, this value even sinks to 0.014 watt H. K. Those sources of light which involve luminescence-effects therefore require less than one-half the expenditure of energy that is requisite in the case of pure temperature-radiators.

This appears quite reasonable, if the mechanics of illumination be regarded on the electron theory. We may note, too, the bearing on the theory of the Welsbach mantle, of the fact that the energy-equivalent of the incandescent gaslight ranks with that of the electric arc lamps. The peculiar composition of the Welsbach mantle, therefore, seems to admit of electron-vibrations being excited by pure heat-effect to an extent that is otherwise only possible by the aid of electrical stimulus. The undeniably strong selective radiation of the Welsbach mantle, at any rate, does not alone suffice to explain the extremely low value of the energy-equivalent of the incandescent gaslight.

# Recent Progress in the Voltaic Arc

By Isidor Ladoff.

We will review the field of electric lighting starting in with the ordinary carbon arc, then discuss the various improvements of this arc by means of adding to the carbon various non-carbon ingredients. Here we will pay special attention to the so-called mineralized arc. We will then treat the exidic or electrolytic arc, finally the metallic arc. For the purpose of completeness, we will touch upon the most important features of the progress in the non-carbon filaments, as far as it throws some light on the evolution of the voltaic arc. However, we will leave out of consideration the latest developments in the metallic filament, as they are still fresh in the memory.

The electric arc light was first produced by Sir Humphrey Davy, in 1810, who employed a galvanic battery of two thousand cells to generate the electric current, and used pieces of boxwood charcoal, held in metallic clamps, for the terminals or electrodes of the light. These clamps were moved toward or away from each other by hand, and such adjustment given them as was necessary to insure the production of an arc between the pieces of carbon held by the clamps.

In conducting his experiments, the pieces of charcoal were arranged in a horizontal plane, and the current of air flowing between them operated to distort the bridge of luminous gas or vapor and bend it into the form of an arch, and it was due to this fact that the light got the name Arc Light.

Owing to the great cost of the battery, and to the insufficient and inefficient light produced by reason of the rapid combustion of the soft charcoal points, and to the lack of any mechanism for automatically adjusting the electrodes to compensate for their wearing away in burning, the arc light of Davy was not produced except on somewhat rare occasions.

In 1844 Foucault substituted for the common charcoal pencils of Davy, pencils or electrodes made from hard gas carbon, which, owing to its hardness and density, insured the production of a persistent arc light.

The next step in the art was the devising of suitable devices for feeding the carbon-electrodes toward each other, to compensate for their wearing away in burning, and to effect this result, different constructions and types of arc lamps or regulators were invented. The earlier forms of arc lamps or regulators were ordinarily constructed so as to preserve the arc constant at a fixed point, as in the focus of a lens or reflector, and in accomplishing this result, the regulating mechanism was constructed so as to feed the upper or positive carbon, twice as rapidly as the lower or negative carbon, because, in burning, the positive carbon burns away twice as rapidly as the negative carbon. Among the early forms of arc lamps was that invented by Foucault in 1844 and manufactured at about that time by Duboscq, the famous instrument maker of Paris. This was what is known as a clockwork regulator, and was exceedingly delicate and complicated in its construction and was incapable of automatically separating its electrodes and establishing an arc between them. However, the arc light was rarely employed at this early period, its occasional use being limited to theatrical representations and the scientific lecture room, and then an exceptionally bright light was required for a short time only.

Further progress in arc lighting was delayed owing to the want of some cheaper source for the supply of electricity on a larger scale than the voltaic battery was capable of. This much needed improvement was realized by the development of the magneto or the dynamo-electric machine, in which a powerful current of electricity is produced by revolving coils of wire in a field of magnetic force furnished by powerful permanent electro-magnets. In 1857 or thereabouts, an impulse was given to arc lighting by the construction of the very large Holmes and Nollet machines made by the Alliance Company. Several new forms of arc light regulators were devised soon afterward, and of the number, the Serrin lamp was one of the most noted for its efficiency. Although complicated and delicate in its construction, the Serrin lamp was used to a considerable extent in the light-houses of France and England. About this time the Foucault regulator was so modified that it was rendered capable of automatically separating its carbons and establishing the arc.

The Gramme dynamo-electric machine brought out in 1870 was a most important invention in the art of electric lighting, because it was specially constructed and adapted to produce in an economical manner, current of sufficient strength for use in operating arc electric lamps.

However, the introduction of arc lighting for general purposes of illuminating was further delayed for the following reasons:

First:—The lamps produced up to this time were costly in construction, and their mechanism was so delicate and complicated as to render them unsuitable to be placed in charge of ordinary and unskilled workmen.

Second:—Arc electric lighting by any of the arc lamps that had been produced up to 1870, was altogether too expensive to have admitted of its adoption or of its substitution for gas lighting. This prohibitory expense was due to the fact that each lamp required a separate dynamo and a separate circuit for its operation. No lamp had been devised of which several could be continuously and simultaneously operated in a single circuit. Further, the cost of attendance for renewing the carbons of the lamps was unduly great, owing to the fact that no lamp had been devised which was capable of maintaining a continuous light longer than for a few hours and for a part of a night.

Mr. Charles F. Brush, of Cleveland, Ohio, the inventor of the double-carbon lamp, patented an arc lamp, May 17, 1878, No. 203,411, which was tested and reported upon most favorably by a committee of the Franklin Institute of Philadelphia, in the spring of 1878. This lamp was undoubtedly a great advance over any arc lamp that had preceded it, and owing to its cheapness and simplicity of construction, its reliability and steadiness in operation, it was by far the best adapted for commercial use of any arc lamp that had been produced up to this time. However,

this lamp, like all other lamp regulators that had been made, was incapable of being operated in series, and hence, its use was of a limited character.

In the fall of 1878, Mr. Brush produced his well known series arc lamp upon which he obtained letters patent No. 212,183, dated Feb. 11, 1879. This lamp was so constructed that it would automatically establish the arc, regulate the length of the arc, and feed the carbons to compensate for their wearing away in burning, and maintain a steady light of uniform brilliancy throughout the entire time of burning a single pair of carbons. In addition to all this, it was also capable of being burned in series with a large number of other similar lamps on the same circuit. In fact, from sixty to one hundred such lamps could be and are operated in the same circuit, current being supplied to all of them from a main single dynamo. It was undoubtedly the most important and valuable invention that has been made in electric arc lighting, and the credit belongs to Mr. Brush. (Prof. Morton, pp. 73-75, C. R.)

In 1810 Sir Humphrey Davy used charcoal points of terminals in his experiments in arc lighting. These points were very fragile; were of loose and open texture, of comparatively high resistance, and could be burned for a short time only, probably not exceeding a fraction of an hour. In 1844 Foucault made a great advance in the art by making the points or electrodes from a hard gas carbon by which the arc could be maintained continuously for a period of from one to two hours. But such electrodes were difficult and expensive to make, and were soon superseded by electrodes made from pulverized carbon, moulded under great pressure into sticks or rods which were afterward baked in a retort. These electrodes were made of a length sufficient to burn continuously from two to three hours, but they were of necessity much shorter than the carbons of the present time.

Various attempts were made to utilize these short carbons so as to maintain a continuous light for a considerable length of time. Two Jablochkoff candles, each provided with a pair of carbons were so arranged that when one candle had been consumed, the other was automatically lighted and burned. But this arrangement could not have been satisfactory and was never put into extensive use.

Another attempt in the same direction, was made by securing two carbons to each one of the electrode holders of a single carbon lamp (reference is here made to the lamp of the Matthias Day patent), but lamps thus constructed or modified never went into use owing to the fact that the arc would necessarily shift backward and forward between the two pairs of carbons so rapidly or frequently as to cause the frequent extinguishment of the lamp, and produce a flickering and unsteady light.

In 1876 or 1877, the Wallace plate lamp was produced and a number were put into commercial use. Instead of employing carbon sticks arranged end to end, and which required frequent adjustment in order to maintain the arc, the Wallace lamps were furnished with two broad carbon plates arranged edge to edge and traveled from one end of the plate to the other when they would be fed toward each other, and the arc would travel back again. The light produced, while it could be maintained for a great length of time, was very unsteady and was so unsatisfactory that these lamps, after being in use for a comparatively short time, were abandoned.

Many other suggestions having the same object in view, *i. e.*, the prolonging of the continuous burning capacity of an arc lamp, were made in publication and patents from time to time, and of the number, one was to make the electrode of a combination of different materials and metals, another was to make the electrodes from a mixture of carbon, metal and other material, and another was to provide the carbon-rod with a strengthening shield or envelop of readily fusible metal, which would so add to the strength of the rods as to enable them to be made of greater length than had been possible with naked carbons. But such composite electrodes never went into use. The metal would have so varied the resistance of the arc and its color as to have seriously impaired the quality of the light. (Prof. Morton, pp. 75-77, C. R. pp. 128-129.)

The history of the prior art in arc electric lighting establishes the fact that as early as the year 1870 electric energy of

sufficient strength and quantity for arc lighting could have been generated by the Gramme dynamo-electric machine so economically as to have insured the introduction of arc lighting on a commercial basis, and that the lack of a suitable construction of arc lamp at that date prevented the introduction of arc lighting into commercial use.

Further, that it was not until the year 1877 (the date of the application on which Brush's letters patent 203,411 were granted that an arc lamp embodying the features necessary to equip it for general and commercial use was produced, and that such a lamp was for the first time introduced by Chas. F. Brush. This lamp was exceedingly simple in its construction, reliable in its operation, not liable to get out of order when in use, and was capable of automatically establishing its arc, regulating the length of its arc, feeding its carbons, and was therefore capable of maintaining an arc of uniform length and brilliancy and of insuring a steady and reliable light during the entire consumption of its carbons.

The history of the prior art also established the fact that the first practical form of arc lamp regulator adapted to be operated in series was produced and put into commercial use by Mr. Chas. F. Brush in 1878, and patented by him in 1879; that this improvement has been universally conceded to have been the most valuable and important invention in arc electric lighting that was ever made because it enabled a large number of lamps to be operated on the same circuit and to be supplied with current from one and the same dynamo.

Further, that the continuous burning capacity of an arc lamp was gradually increased from a period of a few moments only, in the early history of the art, to a period of from one to two hours in 1844, a period of two or three hours at a later stage, and finally to a period of from six to eight and even ten hours, which last advance was made in 1877 (the date of the application on which Brush patent No. 196,425 was granted), and was made by Mr. Chas. F. Brush, and that this improvement was immediately recognized as being a great advance in the art and was quickly adopted and went into extensive use.

The Brush arc lamp of patent 203,411, when equipped with the Brush carbons of patent 196,425 produced the steadiest, longest-lifed and most economical arc light the world had ever known, and constituted the first practical and commercial arc-light system that had ever been produced. The lamps would burn continuously without a renewal of their carbons from six to eight and even ten hours, and were well adapted for all purposes of electric illumination; but in the event that they were employed for all night lighting they necessitated the extinguishment of the light at some period of the night; the removal of the stubs of the nearly-consumed carbons and the replacement of a fresh pair, and hence an attendant had to go about and renew the carbons of the lamps when used for all-night lighting. In order to reduce the cost of arc lighting to the minimum, Mr. Brush set himself to work to devise some plan for prolonging the continuous burning capacity of an arc lamp to such an extent and in such a manner that it would burn all night without necessitating the extinguishment of its arc or a manual renewal of its carbons, and without sacrificing the quality or steadiness of the light. In short, Mr. Brush made the lamp automatically do the work that had been previously required of an attendant.

It is worthy of note that the electric arc light received its impetus as a practical technical proposition from an invention that could not be called a strictly carbon arc. We mean the so-called Jablochkoff Candle in 1872 (German patent 1877). As known, the carbon electrodes were used in this invention only as heat producers while the principal light was supplied by a so-called columbine composed of kaolin, porcelain clay. The candle consisted of two carbon rods placed side by side on a base and isolated from each other by the above named composition. Later on, the porcelain clay was replaced by a mixture, two parts of sulphate lime and one of sulphate of paryta. This mixture had the advantage of not melting in the carbon but volatilizing and making the arc rich with the luminescent particles. Consequently, the success of the arc light industry was chiefly advanced by a system of illumination based on luminescence rather than incandescence of carbon. In connection

with this, we will mention Jamin's improvement, who caused his carbon to impinge upon a cylinder of chalk, lime or magnesia. This arrangement had the effect of very greatly augmenting the amount of light and of toning its color from violet to yellow, green or white by the action of the oxides. Next to the Jamin Candle, the Sun lamp invented by Clark combines in its construction the incandescence of carbon and the luminescence of non-carbon substances. The lamp was composed of a metal frame, to which was attached a block of marble magnesia through which carbons were transmitted, the form of the opening through which they passed being so shaped that, as they slided down, they by their own weight or that of the weight attached above them, were prevented from passing through, their points entering the cavity in which the light was produced. The arc was of exceptionally great length varying from .39 to 2.36 of an inch. After the success of the Jamin Candle and the Sun lamp, the attention of technical men was called to the carbon arc which was developed gradually to its present stage of perfection. At the same time, there were constant attempts on the part of many inventors to try and improve upon the ordinary carbon arc. It is of great historical as well as technical interest to follow up the trend of these inventions from the earliest date to our present time. Some of these attempts at improving the carbon arc amount indeed to very little if anything. Some of the inventions are purely imaginary, some of little practical value, yet the review will prove instructive.

A glance at the table given below will convince us that:

1. The highest spherical candle-power is obtained by the flaming arc of Bremer. (This is due chiefly to the luminescence of the metallic salts, with which the Bremer carbons are saturated. This arc is called a flaming arc in contradistinction to the ordinary carbon-arc. The color of the arc, the unsteadiness and slagging of the carbons make the Bremer lamp obnoxious.)

2. The loss of energy in the shape of heat is the greatest in the alcohol lamp and petroleum.

3. The loss of energy in the shape of heat is the smallest in the Bremer and ordinary carbon arc.

4. The cost per hour is the lowest in the petroleum, and next in the Welsbach lamp.

5. The cost per candle-power is in the last analysis the lowest in the carbon arc.

All these data force upon us the conclusion that the carbon arc is so far the most economical source of artificial light. And yet, even there, in the carbon arc, as a source of light is a surprising loss of energy in the shape of heat as the following simple calculation will demonstrate.

In our ordinary source of light 95 per cent of the energy spent is consumed in the production of radiation, whose wavelength is greater than 0.81, *i. e.*, of radiation that does not affect our eyes. These 95 per cent may be considered as totally wasted from the point of view of production of light.

The resin torch used by the savage gave an efficiency of about 3 per cent to 4 per cent, while the carbon arc furnishes about twice as much only.

A steam engine necessary for the production of electric power, has a maximum efficiency of 10 per cent. The efficiency of the dynamo electric machine being 90 per cent, we get only 9 per cent energy. Assuming a loss of 10 per cent in the conductors, etc., there remains to be expended in the arc lamp energy equal to 0.08 per cent of the original energy. However, of this energy expended in the lamp 90 per cent is wasted in the shape of heat and only the remaining 10 per cent alone are consumed in the production of light proper.

The final efficiency of our most efficient source of light—of the carbon arc—is 0.0081 or less than 1 per cent of the total energy expended.

Obviously there is room for improvement in the field of artificial light production.

*(To be continued.)*


## Exit the Illuminating Engineer

Our esteemed contemporary, the *Electrical Age,* has essayed the rôle of prophet, and predicts the early demise of the illuminating engineer as a specialist. By a curious coincidence this direful prediction reaches us on the very day set for the end of the world; in spite of this prediction, however, in the words of that cheerful philosopher, Artemus Ward, "The world continues to resolve around wonst in every twenty-four hours on its own axle tree, and is withal a very comfortable place to live in." Taking all the facts into consideration, we incline to the opinion that both prophets have slipped a cog in their calculations. As to the creditability of the two prophets, there seems little to choose between them.

However, it may be interesting to examine the process of reasoning by which our contemporary arrives at the conclusion stated. The matter is very plain. "Architects have always fixed the light in the edifices they design, and always will." "Fixed" it they have, indeed—in many cases beyond all hope of recovery. But that they will always continue to do so is by no means so plain as our contemporary assumes. In fact, the number of cases arising within the past year in which the lighting of buildings has *not* been fixed by the architects, makes a very reasonable showing, particularly in view of the fact that illuminating engineering as an established science is only some two years old. Our contemporary seems to consider that illuminating engineering is simply a scheme devised by "the interests" concerned in the production of electric lighting apparatus to further their commercial advantages, having its origin in the diversity of new electric lamps which have recently made their appearance, and will exist only until, by the process of the survival of the fittest, the most desirable types have become established—in short, that there is not much to the subject any way. "In a few months an ordinarily trained mind can familiarize itself with the laws governing the distribution of light and the facts about the quality of commercial illuminants." To this we can only reply, *try it.* But the writer has left a loop hole for escape by stating in the same article, "We are quite prepared to admit that it would absorb the entire energies of an individual mind to post itself on the changeful types and the evolution of particular forms of electric lighting," to say nothing of gas and acetylene illumination.

Notwithstanding this, the writer goes on to say:

> By years of training the architect becomes intuitively familiar with the use of colors in decoration and with the esthetic distribution of lighting fixtures. It is impossible that an engineer will ever get this intuitive knowledge, and so it is that urging engineers to "study" this sort of thing is like carrying coals to Newcastle.

It is certainly most desirable and reasonable that the elements of illuminating engineering form a part of the instruction given in the technical schools, and this will undoubtedly be done in the near future. Certain phases of the matter will also continue to be regulated by architects. Furthermore, many architects will doubtless be their own illuminating engineers, as they are now their own structural, sanitary, and heating and ventilating engineers. Such a combination of qualities is essential to the architect in the small town,

just as it is necessary for the physician in the same town to be a surgeon, dentist, oculist, and general practitioner. The fact, however, that the architect has acquired the science of illuminating engineering for his own individual use does not in the least detract from the position of illuminating engineering as a distinct branch of science.

Continuing, the writer says:

When it is clearly understood that knowledge of this sort is a desirable part of the equipment of an architect, it is only a question of time until schools of architecture get definite courses on the subject and text-books contain adequate instruction on the use of illuminants. While we realize that prophecy is a dangerous art, we nevertheless predict that after a few years the matter of illumination will not be a problem for electrical experts at all, but a matter for the regulation of architects.

Experience has long been considered the best of teachers, and familiarity with the subject produces a certain facility which becomes an intuition. Without such experience and intuition the work of the illuminating engineer, or any other engineer, is sure to contain more or less idiosyncracies. In view of the numerous blunders, both from the practical and esthetic viewpoints, that have been perpetrated by architects in lighting installations, it is somewhat amusing to have the virtues of their intuition as to the esthetic distribution of lighting fixtures set forth as a valuable guide. Just why it should be impossible for an illuminating engineer to obtain "intuitive knowledge" as to the placing of lighting fixtures, even from the esthetic standpoint, is not made sufficiently clear to appeal to our understanding.

We have no desire to decry the merits or works of architects. While the proportion of incompetents to competents among architects is no larger than among engineers, or other professional men, there is no sufficient proof that as a class they are gifted with special inspiration. In common with other mortals, they become proficient in proportion to their ability to study and to apply their knowledge. As a matter of fact, however, the architect and the illuminating engineer are not competitors, and should not work at cross purposes. Their labors are complementary, even if their views of each other are not always so.

After having consigned the illuminating engineer to limbo, and replaced the architect upon his pedestal, the writer proceeds to shy a brickbat at both by referring to the illumination of the Engineering Society's Building in New York, of which he says "no more miserable work can be cited."

Attention has already been called in these pages to the lighting installation of this building and to the fact that when the plans were being drawn, a member of one of the leading scientific societies, for whose accommodation the building was being erected, urged upon those having the design and construction of the buildin charge the advisability of employing a professional illuminating engineer in connection with the light installation. After much correspondence and shuffling of responsibility from one official to another, the proposition was finally rejected on the ground that the architect and electrical engineers were fully competent to handle the problem. Put this statement and the opinion of our contemporary, just quoted, together, and draw your own conclusions.

## The New Electric Lamps and Illuminating Engineering

At the last meeting of the New York section of the Illuminating Engineering Society, Dr. Sharp gave a very interesting description of the general principles upon which the new high efficiency metallic filament lamps are constructed, illustrating his remarks with a well-chosen collection of specimens. The discussion that followed was rather brief, but some most excellent points were brought out. Perhaps the most noteworthy were those made by Mr. Doane, chief engineer for the National Electric Lamp Association. Mr. Doane emphasized the fact that the Illuminating Engineering Society and the science which it represents, came into being at the psychological moment. Had illuminating engineering never been demanded before, the conditions arising from the introduction of these new and revolutionary factors in electric lighting would have made its existence a necessity. The metallic filament lamp is an exceedingly valuable improvement in itself, but it must be handled with a degree of intelligent appreciation of all its qualities which amounts to engineering skill.

Mr. Doane also corroborated the opinion which we have repeatedly expressed, that improvements which lead to a reduction in the cost of producing light invariably create additional demands for illumination which more than offset, in the total, the difference in the cost of production. The apprehension felt in some quarters, that the introduction of a lamp requiring only one-third of the current of those now in general use would make serious inroads upon the income of lighting companies, does not rest upon any established fact or precedent. On the contrary, every improvement has ultimately produced a large increase in the total amount of lighting business. The fact that there are more candles made and sold in this country than ever before was happily cited by Mr. Doane, as confirming this statement.

Mr. Doane also took the ground that, on account of the almost daylight value of the rays from these new lamps, electric light would find a much larger use in domestic illumination than heretofore, since all the effects of decoration, including paintings and other works of art, would show their full beauty by night, when the home is used by all the members of the family. This argument is certainly plausible, and undoubtedly will hold true to a considerable extent. Habit, however, is very hard to change by mere force of reasoning or argument; the mellow light of the candle, the gas flame and comparatively speaking, even of the old-time electric lamp, is something that we have become accustomed to from immemorial usage, and there will be many who will be very loath to exchange this time-honored illumination for that of the most exact scientific similarity to pure sunlight. In fact, at a meeting of this same society not so long ago, much interest was aroused by a discussion of the possible means of coloring or softening the light of these new light sources. However opinions may differ as to the relative advantages of illumination of day-light quality, and the mellow, gas-light effect, the fact must not be lost sight of that the metallic filament lamps, by affording a more nearly white light than has heretofore been available, greatly widen the field of illuminating engineering, and permit of a choice of effects that have hitherto been out of the question.

A remark of Dr. Sharp should be particularly noted, namely, that whereas in certain cases a carbon filament lamp may be tolerated without the use of any means of diffusion, the use of metallic filament lamps in a similar manner is not to be considered under any circumstances; they must always be used either with frosted bulbs, or in connection with diffusing globes.

Mr. Doane pointed out the interesting fact, on the commercial side, that the total production of Tungsten lamps in this country during the present year will not exceed 1,000,000, which will be far less than the normal increase in lamp production for the same period of time. There need be no fear, therefore, that the "old reliable" carbon filament lamp is to be immediately supplanted. The mere exigencies of manufacture are bound to continue it as the leading factor in electric lighting for a considerable number of years to come.

## Gas Lighting in America

The discussion started by the statement in these columns some six months ago, to the effect that gas lighting was being driven to the wall by the electric light, has not entirely subsided. Our views upon this subject, as originally stated, were more or less misunderstood, which led to an attempt to further elucidate the matter in a subsequent discussion of the subject, but even this explanation does not seem to have entirely cleared the air. *The Journal of Gas Lighting* (London) construed our explanation in the light of an apology, or, as it expressed it, "amende honorable." While we should certainly be frank in making such an "amende" were we convinced that injustice had been done, we see no occasion for it in the present instance. Our attitude has never been one of unfriendliness toward the gas lighting interests; on the contrary, our sole purpose in calling attention to what we still believe to be a fact, was to arouse the gas companies to action before it was too late. Without wishing to assume any undue credit in the matter, it is a satisfaction to observe that there has been a very considerable awakening of interest and increase in effort on the part of gas companies along the lines indicated in our original discus-

sion of the matter since we first brought it to public attention. As a single instance may be mentioned the very pointed and well-chosen remarks upon the subject contained in Mr. Clark's address delivered at the National Commercial Gas Association Convention.

The unexpectedly rapid introduction of the high efficiency electric lamp should be a powerful spur to the gas lighting interest, since it threatens their chief stronghold—economy. The thorough study and application of the principles of illuminating engineering on the part of the manufacturers of these improved lamps should also furnish an object lesson to the gas companies.

The inverted gas burner, together with the material improvements in mantle-making, furnish to a certain extent, an offset to these improvements in the electric light; but unless advantage is taken of these improvements in as aggressive and scientific a manner as that used by the electric lighting interests, they will not avail to maintain the position now held by gas lighting. The most successful article is not always the one that has the most intrinsic merit, it may be, and very often is, the article that has the best organized selling force back of it. The chief point which we have contended for throughout this discussion has been that the electric lighting interests are more alert, and more alive to the progressive spirit of illumination, in pushing their wares, than are the gas lighting interests.

Our London contemporary finds our statement that, "to brand an article as cheap is to 'queer' it in the eyes of the American public," a psychological paradox too deep for it to solve, in view of the fact that America is confessedly a commercial nation. We can see how the statement would be difficult for one not born and bred an American to fully understand, but the fact remains nevertheless. The American is notoriously extravagant and improvident. When he acquires wealth, it is by making an enormous income rather than by trimming on his outgo. The average American is a despiser of small economies. These are not racial characteristics, but are incidental to the development of all new countries which are rich in natural resources. While the American may drive a close bargain, and look after small items of cost which may reach a respectable aggregate, he is particularly averse to being publicly considered either penurious or small in his dealings. He will pay twice the price for an electric light that he would for equally good illumination from gas, for the same reason that he will pay double price, so far as the actual accommodations are concerned, for the sake of having his name upon the register of a hotel known to be "first-class"; or what may be easier for our English friends to comprehend, the American will use electric light for the same reason that he will travel first-class on English or European railways.

## Central Station Policy Toward High-Efficiency Lamps

Our discussion of the commercial significance of the Tungsten lamp in the last issue has brought forth a very interesting communication from the manager of a Southern Central Station, which will be found in the Correspondence Department. The tenor of this communication is certainly most gratifying to those commercially interested in the general advance of illuminating engineering, as well as to the general public, who are the users of light.

A similar view of the situation was taken by Mr. Arthur Williams, of the New York Edison Company, at the recent meeting of the Illuminating Engineering Society.

There are two general policies for the conduct of any business enterprise, which may be termed the near-sighted and the far-sighted policies; the former considers only the immediate gains; the latter considers not only present gain, but future prosperity and expansion. The former is naturally opposed to all innovations, whether in the line of scientific improvements or business policy, which will in any way tend to curtail the daily income, while the latter looks into the future and considers the results to be obtained a year, or several years, hence. The advantages of the far-sighted policy, especially with corporations operating public franchises, are too apparent to require argument. Thoughtless political agitation and unjust legislation may be more often traced to the near-sighted policy on the part of public service corporations than to any other single cause.

So far as we have been able to ascertain, however, the central stations have taken the far-sighted policy in regard to the new high efficiency electric lamps in such a large majority of cases, that the exceptions are scarcely worth mentioning. In fact, the demand for these new light-units is so far in excess of the supply that there is no likelihood of the manufacturers being able to catch up for years to come, although they are pushing ahead with all possible speed.

If there is one axiom which the lighting interests of all kinds should keep in mind, it is that "light begets light." The lighting field has as yet only been touched around its borders, and is so broad and so long that all forms of illumination may expand without hardly more than touching elbows.

## Commercial Rating of Gas

Our London correspondent expresses the opinion, based upon his observations in a field with which he has long been familiar, that the commercial rating of gas by its calorific, rather than its illuminating value, is likely to come into general use in England in the near future.

Such a practice is certainly not only justified, but actually demanded by the present conditions of the gas industry. Not only in the use of gas, for general heating purposes, which has reached an enormous aggregate, and which is continually on the increase, but in its original use as a luminant, is its calorific value the item of prime importance. The introduction of the Welsbach mantle burner saved the day for gas as a luminant when threatened by the advent of the incandescent electric lamp, and its future position in the lighting field will depend upon its use in connection with the incandescent mantle. It is true that there are still many millions of gas flames in use; but they are not necessities, they are only relics, and might readily be supplanted to advantage by the far more economical and satisfactory incandescent burner.

For some reason governmental regulation has struck the gas industry with greater force than it has the electric light industry, with the result that the price of gas has either been arbitrarily reduced or voluntarily lowered as a matter of business discretion; and the end of this process is not yet in sight. Decisions already handed down by the highest courts should convince the public that the gas industry is not to become a field for general plunder, and that the gas companies are to have a fair and reasonable chance to pay dividends. It is, therefore, to the consumers' interest to further any improvement which will reduce the cost of producing gas without reducing the properties which make it valuable for their use. To increase the cost of producing gas in order to increase its illuminating value is a wholly useless operation, and one which ultimately is charged up to the consumer.

Gas has been enabled to hold its own against the electric light for the reason that it is a cheaper luminant. This advantage is being threatened by the introduction of electric lamps, both of the incandescent and arc form, which are practically three times as efficient as the older forms. In order that gas-light may successfully compete, therefore, it is essential that every possible means of cheapening the production of gas be taken advantage of. The public is directly interested in having competition maintained between the two great sources of light, and it is therefore decidedly to its advantage that the gas companies be not hampered with out-of-date requirements as to the quality of their product and methods of its commercial rating.

The subject of calorimetry may seem to have little connection with illuminating engineering; but if the measurement of the calorific power of gas is to be substituted for the measurement of its illuminating value, it will not be entirely without the field of the illuminating engineer. We are, therefore, giving in another section of this issue a brief description of a newly designed apparatus for the commercial testing of gas on this basis.

## A Correction

In the March issue, the article describing the illumination of the "Terminal Building," was credited to Henry Goldmark; Mr. Chas. Goldmark was the author.

"From H. M. Hirschberg, of the Excandescent Lamp Company," should have read, From A. S. Terry, of the Sunbeam Incandescent Lamp Company.

# Correspondence

## From Our London Correspondent

It is certain that at no very distant date the testing of gas for calorific power will become universal in Great Britain. The London, Metropolitan, Gas Referees, in their "Notifications" include instructions to be observed, and particulars of apparatus to be used for estimating the calorific value of gas. The calorimeter authorized is the one devised by Prof. C. V. Boys, F.R.S., which is known as the Boys Calorimeter.

There are two other instruments in use in Gas Undertakings, outside the Control of the Gas Referees, viz., the Simmance-Abady Patent Calorimeter and the Junker Calorimeter; both are fairly well known by gas engineers, and have been frequently described in the several journals devoted to gas manufacture and illumination. The illustration gives a general view of this new Recording Gas Calorimeter, and the diagram will, we trust, make the working parts and use of the apparatus quite clear.

The production of gas for power, lighting, and heating purposes has increased to enormous proportions. Producer gas is very extensively manufactured, and the operation of a gas producer of any type successfully will depend largely upon the quality of gas turned out, and particularly is it desirable to have a ready means of ascertaining the heat, or calorific value, of the product. There is the same need for knowing the calorific value of gas when used in gas engines for power purposes; but perhaps the paramount necessity for ascertaining calorific value is in connection with gas supplied for lighting purposes, especially now that the bunsen burner in association with the incandescent mantle is so generally the means of obtaining illumination. It is generally accepted that, in the near future, calorific value must take the place of the candle unit as a standard test.

There is therefore a real need for some reliable instrument that indicates clearly and accurately the calorific value of gas, Such an instrument should not only indicate the value, but automatically record the readings. When this instrument is commercially upon the market it will be extensively taken up by manufacturers of gas, whether for lighting, heating, or power purposes.

It may be well to note here that the colorimeters that are now in general use for determining the thermal value of gas are controlled on the absorption principle; the heat developed by the burning of gas is absorbed by water contained generally in a metal jacket which surrounds the flame. If the quantity of gas burnt, and the quantity and temperature of the water used are both known, the calorific can be obtained by calculation. It is open to question whether instruments working on this principle give a thermal value of the fuel tested that is comparable with the actual results obtained in practice; in the case of some gases, it is well known that the results are considerably too high.

We are intending to describe a new instrument, the Beasley Recording Calorimeter, for which no water supply is needed. It is also claimed that there is nothing of a complicated nature in its mechanism, and no delicate parts liable to give trouble when the control of the instrument is left in the hands of unskilled workmen. The action of the calorimeter is entirely automatic; it is self-contained, and, what is perhaps the best feature, gives clear, permanent records of the calorific values of the gas tested. In designing the instrument the main idea has been that the indications should represent, not the total number of thermal units actually generated by the burning in air of a unit

weight or volume of gas, but the number of heat units available for practical purposes.

When a gas containing free or combined hydrogen burns, water is formed. If this water is to escape from a gas engine or any apparatus in the form of vapor, then a considerable percentage of the total heat of combustion of the gas is lost in vaporizing. It will therefore be apparent that of two gases having the same total heats of combustion, the richest gas, from a practical standpoint, is the gas of least hydrogen. The total heat generated by the combustion of unit volume at 760 mm. pressure, 0 degrees Cent., or by unit weight of a gas, is generally known as the *high value* calorific power of the gas; it is a value which for simple gases is given in all standard books on thermal chemistry. This high value for calorific power, less the heat for vaporizing any water combustion, is defined as the *low value* calorific power, and is, of the two, by far the most important value.

In water-cooled calorimeters such as are scheduled by the London Gas Referees, the products of combustion are lowered to the temperature of the air by a stream of water, the rise in the temperature of the water being accepted as a measure of the calorific power of the gas. By reason of the water vapor formed by the combustion of the gas condensing inside the instrument and liberating its latent heat, the calorimeter indicates and records the absolute and high calorific power of gases, and therefore for this reason, if for no other, is not so serviceable as an instrument designed to record the practical low calorific value, and which may be read to a thermal scale, comparable with the results met with or expected in actual practice.

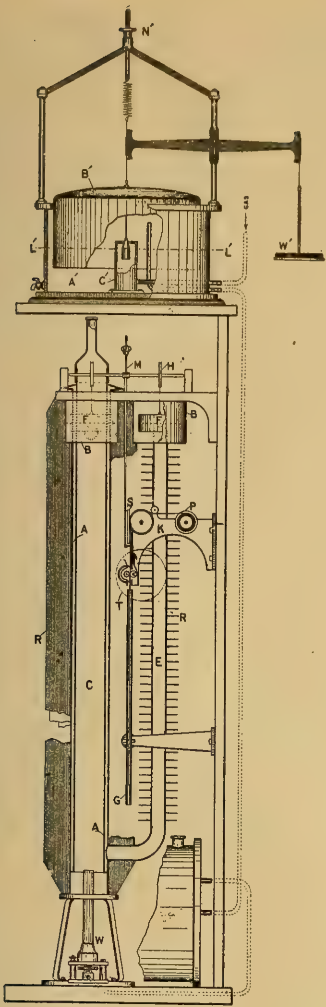
In the Recording Calorimeter under review the gas is burned in a good supply of air in a radiating chimney. As the products of combustion leave the instrument at a temperature of about 70 degrees Cent., no water is condensed, and by virtue of this the calorimeter gives the *low value* calorific powers and not the *high values*. The average temperature attained by a chimney of a relatively large heat capacity is directly in proportion to the heat generated by the burning of the gas, provided the range is confined to low temperature.

The principle involved is the burning of a constant stream of gas in a radiating chimney, and the automatic recording of the temperature difference between the chimney and the air. For this purpose a differential thermometer is used which takes advantage of the proportional expansion of oil with rise of temperature. Thus, if one limb of a U tube filled with oil heated to a temperature above that in the other limb, the oil in the hot limb rises to a level above that in the other limb by an amount proportional to the difference in temperature, the actual level in the cold limb remaining constant. The volumes alter with the temperature, but the respective weights of the two columns remain the same. For this reason in a plain U tube there is no circulation of oil from one limb to the other; when however the hot limb of a U tube, filled to the brim with oil, is made to terminate in a tank, so that before the level of the oil in the heated tank can rise in proportion to its change in density it must overflow into the tank, and thus draw oil from the cold limb; by having proportional tanks to each limb it is easily possible to obtain a respective rise and fall of the oil level in the tanks in direct relation to the difference of temperature between the hot and cold columns of oil. By means of floats and a simple integrating gear, this difference may be readily recorded on a moving band of paper.

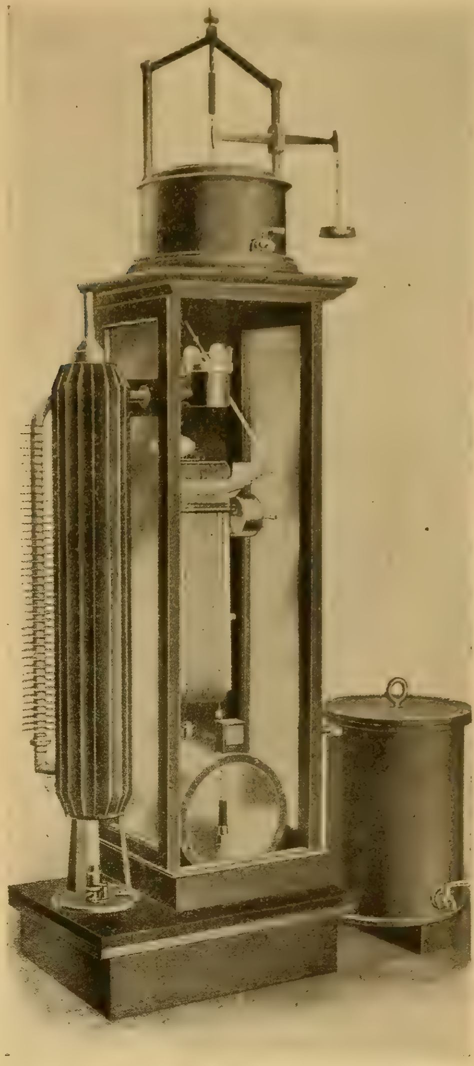
Fig. 1 gives the general appearance of the calorimeter, and Fig. 2 shows a sectional diagram, of which the following is a detailed description. A U-shaped vessel, one limb of which is formed by the annular space *AA* between the concentric walls of a vertical chimney, *C*, is provided at the top of each small limb with a small tank, *B*, and contains enough oil to fill the tube *AA* (which is in the form of a jacket surrounding the chimney *C*) and the cold limb *E* and also to partly fill the two tanks *BB*.

The gas to be examined is burned in an atmospheric burner, *W*, at the bottom of the chimney, and the oil in the heated limb *AA* rises to a level above that of the other limb, *E*, corresponding to the increased temperature.

The difference of level is therefore a measure of the calorific value of the gas, and is recorded automatically by means of two floats *FF* situated in the tanks *BB*




BEASLEY CALORIMETER—SECTIONAL VIEW.



BEASLEY CALORIMETER—PERSPECTIVE VIEW.

and connected by threads to two pulley wheels arranged upon a horizontal spindle, *H;* this spindle rotates as the floats rise and fall, respectively, and operates a lever, *M,* carrying a masher, the latter tracing a diagram upon the moving band of paper by the clockwork *T,* and ruled with a scale which indicates the low calorific values.

The paper gear is shown built upon the bracket *K.* The supply for one week's run is wound on a wooden spool and is transferred for use to the roller *P.* By means of the clockwork *T* the paper is drawn over rollers passing the back of the scale *S* in contact with the marking pen *M* to the long paper guide, *G* which is sufficiently long to allow the exhibiting of a record of twenty-four hours' duration.

The pressure regulator shown at the top of the diagram is of the ordinary type, but the dimensions and weights of the different parts have been very carefully considered and specially worked out to meet the requirements.

The Beasley Calorimeter has been tested and found to be very insensitive, to normal changes, (a), in the temperature and humidity of the atmosphere; (b), the conditions of the radiators; (c), to the state of the inside of the chimney. In the tests referred to, the steady records of the calorific value of an homogeneous gas were not affected by as much as 1 per cent. by

the setting of large quantities of dust on the radiators, and in a second case by the abnormal coating of the inside of the chimney with soot from the burning of machine oil.

The gases used for standardizing the instrument are hydrogen and carbonic oxide, the latter gas being very convenient as it can be prepared in a very pure state by the decomposition of Formic acid with Sulphuric acid. The gas is generated (in large flasks), washed with water and Caustic soda, and then stored in a large gas-holder. It is tested in the Hempel apparatus foi $CO_2$ (which should not be present), and also for Oxygen. The calibration of the colorimeter is also checked by the use of pure Hydrogen.

We might add that the Beasley Recording Calorimeter is furnished in polished slate and mahogany and stands about seven feet high; occupying a floor space of about three square feet; the whole apparatus weighs about 200 pounds.

CHARLES W. HASTINGS.

## From Our Readers

The following letter in regard to the general progress in lighting during the past year was received too late for publication in our last issue:

ILLUMINATING ENGINEERING PUB. CO.,
New York City.

GENTLEMEN:

In reply to your letter of the 27th ult., relative to information as to the year's progress in the field of illumination, would say that I will give you what information I am able to, which, however, will be but little, as I have been so busy recently that I have not had time to collect much data along these lines.

As to the progress during the past year that this company has made in the way of new business, would say that on January 31, 1907, we had a total connected lighting load of the equivalent of 214,563 16 c.p. lamps, and the equivalent of 167,789 16 c.p. lamps in power service, making a total connected load of the equivalent of 382,352 16 c.p. lamps. On January 31, 1908, the total connected lighting load was equal to an equivalent of 335,263 16 c.p. lamps, and the total connected power load equaled the equivalent of 221,284 16 c.p. lamps, making a total of 556,547. On May 1, 1907, we had no special street lighting, that is to say, no lamps on posts or brackets used solely for street lighting purposes, and at about that time began introducing ornamental iron posts, equipped with two four-glower Nernst lamps. These posts were placed along the curb at intervals depending upon the number of customers to the block or upon how many each customer agreed to pay for. We also have a standard ornamental iron bracket which is fastened to the face of the building, supporting the lamp about eleven feet above the sidewalk, and on which is hung a six-glower Nernst lamp. From May 1 to January 31, 1908, we had installed 105 three-glower Nernst lamps on these posts, seventy-two four-glower Nernst lamps and twenty-seven six-glower lamps on brackets. On January 31, 1907, we had 111 No. 5 Gem units installed in the city. At about that time we began pushing the Gem unit, and upon January 31, 1908, we had 1498 No. 5 Gem units, 342 No. 4 and 3413 No. 3s.

There are no Tantalum or Tungsten lamps in use in this city, as yet, the reason for not using the Tantalum being that we have a complete alternating current system. The only thing we have done with the Tungsten lamp was to make a life test on some of their low voltage lamps. This test was made on four 50-watt and four 25-watt, 27 volt, double filament G. E. Tungsten lamps. These lamps were fitted into a Dale cluster, which supported the lamps at an angle of sixty-seven degrees from the vertical, and were operated four in series, on a 115 V. alternating current 60 cycle circuit. The 50-watt lamps have burned 230 hours, in this position, and are still burning. One of the 25-watt lamps burned out in twenty-seven hours, another in forty hours, another in sixty-nine hours, and the other in 243 hours, making an average of 94.8 hours. Our reason for testing the lamps for life when placed at an angle was because of the fact that if small units are to be used in clusters it would seem necessary to us that they be placed at an angle in order to give the proper distribution, as if the lamps were hung vertically in a cluster with reflectors over them, the resulting curve of distribution would be of a very concentrated type, or if a single reflector were used, over the lamps, some of the rays of light from the various lamps

would have to pass through some of the other lamps before they would reach the area to be illuminated. It is not my personal opinion, however, that the low voltage lamp will be a success when used in this manner, as I think that the only lamp that can be made a success is the multiple lamp, capable of operating under 117 V.

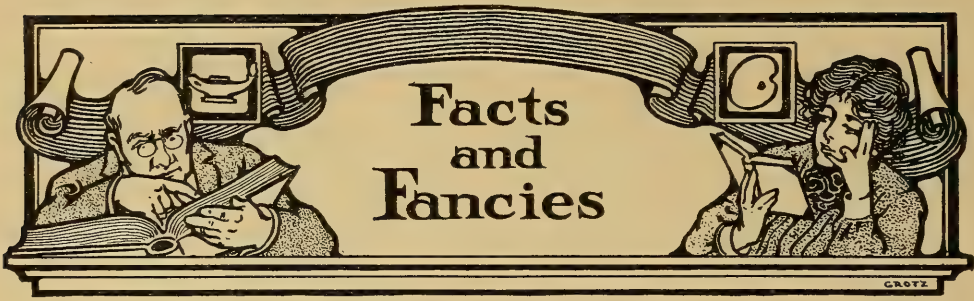
About the first of the year 1907 this company opened up a department which was primarily known as the "Illuminating Engineering Department." This department rendered such services as it could to any of our customers desiring information regarding the best means of illuminating their premises, the principal work, however, being that of calling upon the various architects in the city and assisting them in laying out efficient installations, in order that the company could give satisfactory service when the lamps were once installed. We found that a number of the architects of the city had given but little attention to the matter of lighting of buildings, the greatest lack of attenion being demonstrated in office and store buildings, where in many cases insufficient current capacity was allowed to produce the required amount of illumination, and in other cases excessive installations had been installed, causing the customers' bills to amount to a great deal more than necessary, because of the unnecessarily large amount of current used. When the architects found that the company's motive was purely that of wishing to secure the most efficient installations, for their future customers, the majority of the architects co-operated very heartily with the movement, and very frequently called upon this department for information. Complaints of excessive charges for lighting service are also handled by this department, as it has been found that the big majority of complaints of excessive charges for lighting service are due to inefficient or improperly planned installations and therefore men posted in the matters of illuminating engineering are better fitted to handle these complaints than men who are simply versed in meter and interior wiring practice.

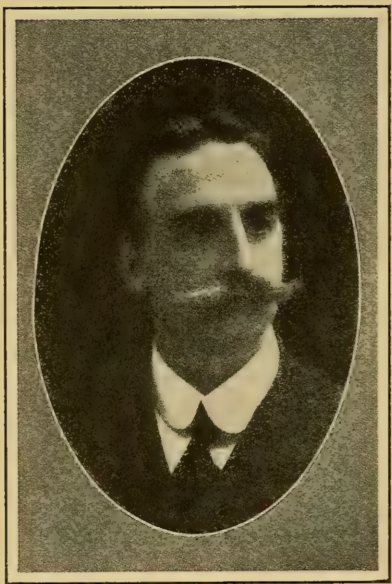
This department has been increased to the capacity of three men, and up to the time of the financial stringency, it was found necessary to have a clerk and stenographer for this one department alone, to handle the office work for the department. The department has undoubtedly been of value to the company in many instances, where large buildings would have been wired with only a capacity of one-third of what would have been required, had not this department gone over the plans before the contract for the wiring was let, and shown the architects how insufficient the wiring was. This of course means that it makes it possible for the central station to supply the future tenants of this building with about three times the amount of current it would have been possible to have supplied to them, and furthermore it means that they can now furnish satisfactory service, whereas, had the buildings been wired according to the original plans, it would have been impossible for the company to have given as satisfactory service.

Trusting that the above information may be of value, I am,

Yours very truly,
W. M. Hamilton,
Installation Engineer.

Portland Railway Light and Power Company, Portland, Oregon.



HERBERT TRENCH,

The English poet whose "Apollo and the Seaman" was given musical illustration in London, inaugurating what is called a "new art."

## "Illuminated Music"

Program music has often been a stumbling block to the uninitiated auditor, because he does not know what the composer is driving at. Sometimes the composer's intention is printed on the program; but when Strauss's "Don Quixote," for example, is being played, the listener in a semi-lighted hall cannot always follow the course of printed events so as to know whether the music describes the attack on the windmill or the sheep running over a hill. London has lately tried an experiment with the problem here indicated. What was called an "illuminated symphony" was performed in Queen's Hall. The music written by Mr. Joseph Holbrooke was played by a large orchestra, partly concealed by a screen upon which were thrown the words of a poem, called "Apollo and the Seaman," by Herbert Trench, the English poet. It is thought by the critic of the London *Times* that the experiment may have "important artistic results," though the consensus of critical opinion seems to be that the first attempts did not result in success. According to the program the intention was "to develop program music by placing the interpretation and intention of the music beyond question or cavil, and thus avoid something of the uncertainty necessarily attaching to analytical programs.'" The new art is described further as "a reversion to the earliest Greek theory on the respective functions of the two arts"—music and poetry, for the means thus offered enable "the eye and the intelligence to cooperate with the ear." Concerning this effort the critic of the *Times* (London) writes:

"All questions of the junction of two or more arts must be solved in the long run by the success or failure of many actual experiments; none can be judged on abstract grounds, for the principle might be wrong, though the first experiment might succeed, and the principle might be right, though the first experiment should fail. In such alliances as that which has long been accepted in the case of opera, or that fusion of all the arts which was attempted in the latest works of Wagner, the great danger is that the musical part of the business will take a subordinate place, unless it is of extraordinary strength and interest. In England, at the present day, we are so accustomed to the sound of music, of one sort or another, going on while we try to write letters, to dine, to talk, or to see a play, that it is difficult to get free from the mental habit of ignoring it altogether."

Mr. Arthur Symons, critic for *The Saturday Review* (London), sees no good in the experiment. Indeed, he asserts that his "disgust and anger at this inartistic affectation of 'new art' is caused in part by my respect for both the perpetrators of it." He adds:

"A better demonstration of the folly of so-called program music was never seen than in

this degradation of two arts, in the attempt to combine both in one substance. No such combination was made, and the fetters in which Mr. Holbrooke had willingly placed himself were heard jingling through the entire performance."

One of the defects of this particular enterprise is that the poet and the composer did not pull together well in the same harness. Mr. E. A. Baughan writes in *The Daily News* (London):

"No doubt the music as a whole illustrates

"A NEW FORM OF ART."

The opening scene of the "illuminated symphony." Folowing this the words of Mr. Trench's poem were flashed upon the screen behind which an orchestra played Mr. Holbrooke's music.

the poem as a whole. The symphony is Mr. Holbrooke's musical expression of Mr. Trench's new immortality—not the fantom of past ideals, but the modern idea that the human race itself makes its own immortality, from father to son. But the very merits of Mr. Holbrooke's score—its sense of form, of cumulative climax, and of well-balanced musical emotion—result in the poem and the music being in opposition at many points. Mr. Trench's stanzas flashed out peace, but Mr. Holbrooke's music breathed defiance and war; or, at other times, the lines on the screen called for a terrific climax, but the music was busy with more mysterious thoughts. I cannot help feeling that the composer did not worry himself with detached illustrations of the poem, and not having done so, all the program we desired to know could well have been expressed within the confines of a single sonnet, or even be embraced by a short title. In a certain sense, then, the composer has supplied a criticism of the poet's idea of an illuminated symphony."—*The Literary Digest.*

## A Novel Complaint—Too Much Light

Generally the demand is for more and more light, and the complaint is (or was) that there is not enough of it. If we were to transport ourselves back but a few years before the advent of the cheap incandescent gas-burner—or, it would seem, if we were merely to enter to-day into an electrically-lighted home at West Ham—we should be astonished at the paucity of light. In Venice, while they are building new gas-works there, they are also changing the old flat-flame burners for the modern incandescent gas-mantles. We learn from our Italian contemporary *Il Gaz* that this change has given rise to an outburst of complaint on the part of some; the reason being that there is now too much light! A circular of protest has been issued which says: "The proper feeling of discontent among the inhabitants at the present poorness of the gas lighting has led the Municipality of Venice to adopt the incandescent mantle along the Grand Canal, smaller canals, and streets. We ask intelligent citzens to sign this protest against such a scandal. The misleading and dazzling light of the Auer burners will destroy the moonlight and all the fascination of the Venetian night celebrated throughout the world for its enchanting beauty." So it comes to be a case of Mantle *v.* Moon! The incandescent gas-burners give too brilliant a light for the soft and silvery moonbeams to have full play over the waters of Venetian canals. Poor moon, can she really be put out by the gas-mantle? We very much doubt it; and from our own recollections of Venetia's waterways, a little more light would have enabled us to see beauties that were hidden in the shade. We are all for the "harmonic lighting effects" and "sacred beauty" of Venice; but we really cannot believe that either will be ruined, or even interfered with, by the economical and effective distribution of light from modern gas-burners. There will always be some "artists" and "aristocratic dames," such as those who have put their signatures to this quaint protest, who wish to preserve the world for their own one-eyed visions.—*Journal of Gas Lighting, London.*

CASHIER BOOKKEEPER CONTRACTS ADVERTISING

# Commercial Engineering of Illumination


Time to Come Out

# Prosperity of Illuminating Engineering in Montana

By George Wilfred Pearce.

As the result from a number of days spent in interviewing the illuminating engineers in the direction of the electric light and power and gas plants that serve the Butte District in Montana, it may be declared that the industry is highly prosperous and is increasing by leaps and bounds. Butte and several adjacent towns are beautifully lighted. The principal streets devoted to retail shops are as handsomely lighted as the best parts of this city. Domestic, church and school lighting is well done, under the direction of competent illuminating engineers. Throughout the zones served by these lighting companies charges for electric and gas and steam heat services are very low indeed. The several stations carry good stocks of fixtures and supplies, and are handsomely fitted up. The best trade periodicals are on file and are read through from cover to cover, letter press and advertisements. One of the principal buyers said that during last year he bought $25,000 worth of goods from one advertiser in The Illuminating Engineer, of whom he heard for the first time through this periodical. Throughout the West the boards of direction of illuminating engineering plants are requiring their men to read the trade periodicals as part of their duty toward employers, and to cause a clipping book to be maintained at each office in which are pasted matters of interest clipped from the local press.

The present population of Butte is almost 60,000. Local "boomers" assert that the city has 65,000—which to say the least is "drawing it mild," for claims set up by real estate "boomers." But Butte and vicinity are bottomed upon great industries which are bound to grow rapidly, and which yield large returns to energetic workers, so that the time is not far away when Butte and its suburbs will have 150,000 inhabitants. Butte's gas plant made 45,000,000 cubic feet last year. On April 1 the city had in service 90,000 16 c.p. incandescent lamps and 1057 arc lamps. Within the same zone and on the same date Phoenix had 3,896 16 c.p.'s and 164 arc lamps; Bozeman, 10,294 16 c.p.'s and 124 arcs; Great Falls, 28,415 c.p.'s and 214 arcs; Livingston, 8716 c.p.'s and 88 arcs.

Besides these services, the same corporation sells a great deal of light and power to mining enterprises remote from the towns. At one isolated place, where dredging for gold is carried on by a corporation composed of professors, tutors and others, at Harvard University, and their friends, the big dredges and the offices and miners' homes are brilliantly illuminated by electricity from the Butte Electric & Gas Company. This mine yielded $100,000,000 in placer gold some years ago, and was then termed "played out." Some time afterward, Professor Shaler of Harvard University visited the place and declared that by going deeper much gold would be found. His judgment has fructified in large returns to the present operators.

In and about the Butte District, it is noticeable that the illuminating engineers are at the fore in all that makes for the promotion of the best interests of the communities. Several officers of the Butte Electric & Power Company are experts in irrigation, agriculture, horticulture, and mining. They write and talk about mining, cattle raising, farming, and merchandising as well as they use their tongues and pens on subjects germane to engineering. What the drug stores and the grocery shops are in the older Eastern towns as centers of information for everybody, the light, heat, and power plants of the West are in that section. The Butte Electric & Power Company has developed 20,000 h.p. by hydro-electric engineering; is developing 20,000 h.p., and has plans for the future construction of 25,000 h.p. The region from which the water flows that actuates the machinery is in and about the National Yellowstone Park, 135 miles from Butte. The main sources of the supply are the great geysers of the Park, which pour down from heights of 10,000 to 12,000 feet to heights of 6000 to 4000 feet above the level of the sea. The rivers that flow from and above the Park

pass through high canyons, in some of which snow remains until summer is well advanced, thus making the flow of the waters almost constant.

A mighty engineering work planned by the owners of the Butte Electric & Power Company is the Hebgen reservoir, named in honor of a gentleman connected with engineering enterprises in this city who for upward of twenty years has been deservedly held in high esteem by the fraternity of engineers. The Hebgen reservoir will cover 13,000 acres—sixteen times the area of Central Park—and will provide storage for 13,000,000,000 cubic feet of water. The watershed is 1000 square miles, of which a part was gone over by the Lewis and Clark expedition sent out by President Jefferson, and was often fought over by some of our great Indian fighters. The largest existing reservoir has the area of nine square miles and the storage capacity of 1,000,000,000 cubic feet. If the natural flow were cut off this reservoir could supply the actuation for 15,000 h.p. during thirty days. The generating machinery throughout the service zone is General Electric Company manufacture. The pipe lines are of Oregon fir, and average ten feet in diameter. The transmission lines are patrolled day and night by mounted men.

As examples of the genius and ability of illuminating engineering, the world does not contain anything finer than these plants within the zone of Butte, Montana.

# The Solicitor's Opportunities

By E. L. Elliott.

## A Paper Read Before the Employees' Association of the Westchester Lighting Company

The measure of success which an individual can achieve depends upon two things: First, his own ability and energy; and second, the opportunities which his chosen calling affords for the exercise of these qualities. Success consists in accomplishing to the highest degree the thing which you set out to do. The person who is satisfied with a result that "will do," or is "good enough," never achieves complete success; for complete success implies not only in doing a thing, but in doing it in the most complete and perfect manner possible under the given conditions and limitations. If the task happens to be driving shoe pegs, they must be driven clear in and smoothed off; it will not do to drive them half way in and then break them off; or leave them sticking part way out. The accomplished task must be so complete that there is absolutely nothing more to be done.

But even assuming that every proposition is thus carried to its complete fulfilment, the grand total of success will depend upon the number and importance of tasks accomplished; in other words, upon the opportunities which the given calling affords.

I wish to call your particular attention to the opportunities which the selling of illumination affords for the achievement of a success that is really worth while.

In the first place, you are dealing with a commodity than which there is none of greater use, or of a more refined and elevating character,—*Light*. This is shown from the fact that light has always been used as the symbol of intelligence, progress, and morality. Whenever you induce another to make a greater or better use of light, you have conferred upon that person a genuine benefit; you have added something to the sum total of human comfort and enjoyment. You therefore need make no apologies, either to yourself or to your clients, for the work in which you are engaged. You can with perfect right and truth consider yourselves "messengers of light" in every sense of that term: there should be inspiration in this thought.

But while you should have a full realization of the high character of your profession, it is needless to remark that this appreciation should not find expression in any air of superiority or assumption of authority. Broad knowledge and modesty always go together. In many cases you will necessarily need to become a teacher; and it is a well recognized fact among successful instructors that the most effective and lasting method of impressing knowledge is to so lead on the recipient that he will believe that he actually discovered the information himself. This holds doubly true in that species of education which is directed towards the selling of goods. There are few people, especially among adults, who do not instinctively resent being flatly and openly instructed; it reflects upon their own knowledge, and wounds their

vanity, if not their actual self-respect. You are convinced of a certain fact in regard to the use of gas or electricity; you want a certain individual to believe that fact as positively as you do. He *may* accept your say-so in the matter, in which case your task is simple; but the probability is that he will have to be convinced by some process of reasoning, in which case there is an opportunity for almost endless skill and diplomacy in leading him through a succession of roundabout paths, in each of which he will follow willingly, until he finally arrives at the destination which you have in view, and accept the truth, either with the feeling that he always knew it, or that he himself has discovered it.

I think it was Demosthenes, the greatest orator of ancient Greece, that defined oratory as "the art of persuading." If we accept this definition, your success will largely depend upon the degree to which you become finished orators. There is always the possibility, at least, of *persuading* another of the truth of your proposition; but of *compelling* him to accept it there is little hope. This "art of persuading" is indeed one of the finest arts in all the range of human activity. It embraces so many qualities; logic,, good nature, verbal expression, manner, personality, all have their effect. Once exercised in its highest form, the process is so subtle as to leave the one persuaded entirely at a loss to discover how the result was brought about. The first essential is to avoid stirring up an antagonistic state of mind in the one you are endeavoring to persuade. The slightest evidence of self-assertion, of superiority, of compulsion, will set up such a barrier of this kind as your most strenuous efforts will hardly be able to overthrow.

The most difficult cases that will therefore fall to your lot are those of complaints. Here you have the antagonisitc frame of mind developed usually to a high degree to start out with, and this antagonism must be entirely reduced, and a contrary state of mind substituted. To make a friend of an avowed enemy is an accomplishment to be proud of. The aggrieved mind increases the tension of its supposed or actual wrongs by contemplation; and the first necessity is always to relieve this tension by allowing the mind to express itself as fully as possible. Let the complainant blow off steam until there is not an ounce of pressure left, maintaining your own mental equilibrium meanwhile with unvarying good temper. No matter how fierce his words of condemnation, or how abusive they may sound, remember that they can do you at least no physical harm, and can do you other harm only to the extent that you allow them to irritate you. The man who has aired his grievance to the limit has exhausted his resources of defense, and is in a favorable condition for receiving suggestions that will bring about a contrary state of mind. There is this peculiarity about the enemy that is converted into a friend, namely, that there is no friend more staunch nor faithful. The complaint department of a lighting company is not usually considered an especially attractive field; but in reality there is none that affords greater opportunities for real ability on the part of the solicitor in securing permanent benefits for his company. I venture to say that there is not one such potential enemy out of a hundred that, by proper treatment, cannot be converted into an active friend. Mistakes are unavoidable; they will sometimes lie with the company, and sometimes with the customer. In the former case recognition of the error and a full and fair restitution will invariably win back the confidence of the customer; if the mistake lies with the customer, it can be shown to him in such a manner that he will recognize it, and feel bound to make amends by a cheeful acceptance of the true conditions.

There is a trite saying that there is no sentiment in business, but a careful analysis of your own experience in this direction will prove to you that the saying contains but a modicum of truth. Personality is to-day, and always has been, the greatest power in the world. There is no combination of capital, nor aggregation of men that cannot be conquered by the individual, providing his individuality is strong enough. The definition of salesmanship as the art of making friends comes near expressing the full truth of the matter; and in no branch of commerce is its truth more complete than in the work of soliciting in which you are engaged. Unlike the representative of the merchant or manufacturer, you are representing a company which is quasi-public in its nature, in that it works under a franchise granted by the people. You therefore have not only to keep in mind the friendship of the individual consumer, but that most potent but whimsical element known as "public opinion." In dealing with a customer, therefore, you are not only treating with an individual who has his own purely personal and selfish ends in view, but who is at the same time a unit of the body politic; and the most inconspicuous of these units may possibly prove to be the "little leaven," capable of setting up a fermentation which will spread through the whole loaf, either for good or ill. You are, therefore, to a greater extent than you perhaps realize, moulders of public opinion. Whether the company you represent is considered a natural enemy and sort of necessary evil, or a public enterprise worthy of confidence and good will, it is to a large

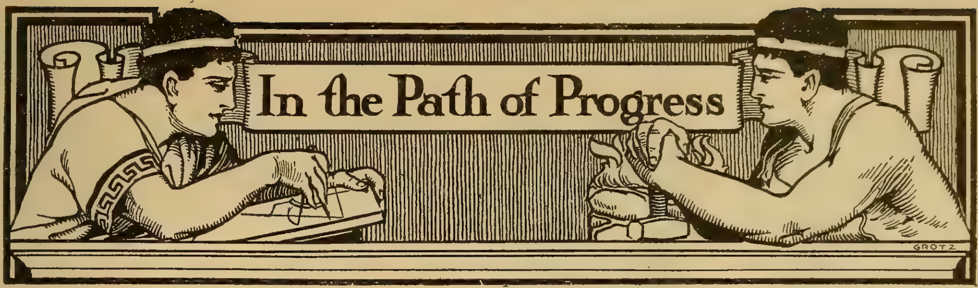
extent in your hands. Of course the general policy of the company, which is determined "higher up," limits your responsibility in this regard to a certain extent; but at the present time the cases are fortunately rare in which the general policy is not founded upon the sound principles of fair dealing and just treatment; you are the ambassadors empowered with the presentation of this policy. In this regard be reminded that the "new diplomacy," which has practically supplanted the old, is based upon frank and truthful representation. The old definition of a diplomat, as "one sent to lie abroad for the good of his country," has been superseded. Mutual confidence is the foundation upon which all lasting trade must be established, and this can only be built up by a rigid adherence to the truth. Generally speaking, you will never be able to make others believe what you do not believe yourself. Elbert Hubbard says that "few men have the courage of their lack of conviction." A faint heart ne'er won either a fair lady nor a good contrast; and the only effective tonic for a faint heart is a consuming conviction of the soundness and truth of your proposition. In salesmanship, "he who hesitates is lost"

This brings us to the most vital part of our subject, and that is the necessity for a thorough and comprehensive knowledge of the goods or proposition which you have to offer. It is impossible to know too much, even of the minutest details, of your "line." It is only the possession of such complete knowledge that gives the unconscious and unoffensive air of authority, without which the solicitor is a mere juggler, depending upon the "tricks of the trade" to catch an occasional order from the unsophisticated. The instant that your prospective customer finds that you know less than he does in some particular point you are on the defensive, and generally have opened the way to an ignominious retreat.

In the general field of the lighting industries, a radical change has been taking place within the past few years. While it still holds true that the consumer buys electric current of gas, and not illumination, the fact is being more and more recognized that the final results obtained from these commodities in the way of illumination must be considered as practically the commodity dealt in. The time is not far off when illumination will be the actual quantity measured, bought and sold. Meanwhile the right of the consumer to receive exact and unprejudiced advice as to the most efficient methods of securing illumination from the amount of luminant purchased, is without question. Herein lies the greatest opportunity at the present time for the ambitious solicitor. The faults arising from the old condition of affairs, in which the production of illumination, being everybody's business, turned out to be nobody's business, which resulted in untold waste of luminant and inferiority of results, is passing away. Progressive lighting companies have already recognized the fact that producing good illumination is their particular business, and that, to the extent to which they advance the principles and practice of illuminating engineering, *i.e.*, good lighting, will they secure both public favor and patronage.

Illuminating engineering is a science and an art, the mastery of which is not beneath the efforts of the most ambitious. There is perhaps no other profession which touches so many sides of human activity, and the most energetic and competent may well spend a lifetime in its study without finding himself in the position of sighing for more worlds to conquer. Do not infer from this, however, that you cannot make great use of the subject without this complete mastery. In fact it, like all other sciences, is progressing so rapidly that complete mastery is out of the question. The first essential is to recognize the fact that improvements are possible in the absence of perfection, and that while you may not be able to reach the latter, you may very often secure the former. Run over in mind a number of lighting installations which have come under your direction or observation, and see if improvements do not immediately suggest themselves.

What surer step toward ingratiating yourself into the good graces of a present or prospective client than by offering at an opportune time a suggestion that will prove of practical value in improving his lighting? Convince a man that you are right in one particular, even though it may be trifling, and you have gone a long way toward being considered an oracle. In this busy country the seemingly most obvious defects in some particular line may be entirely overlooked by those actively interested in another direction. This will account to a considerable extent for the existence of such outrageously apparent defects in lighting as would seem should attract the attention even of the blind.




## A New Miniature Arc Lamp.

Many attempts have been made to secure the higher efficiency and whiter light obtainable from the electric arc, in a lamp of less candle power than the standard size which has prevailed since its first introduction. For various reasons these attempts have never met with a very large degree of success, at least until quite recently. Such lamps have found a considerable use in Europe and have been exported to this country to a limited extent within the last few years.

Queen & Co., of Philadelphia, whose name has been synonymous with high grade scientific instruments for more than half a century, have recently brought out a newly designed lamp of this character, which they style the Queen Acme Arc. The following description and claims for this lamp are furnished by its manufacturers:

The merits of the ordinary large arc lamp are found condensed in this new small, easily handled arc lamp. It gives the light of fifty 16 c.p. incandescents on the current of five. When equipped with opal globe and reflector it gives 800 candle power at 2.5 amperes. With a clear globe and reflector it gives 1500 candle power at 2.75 amperes and opal as above 1000 candle power at 2.75 amperes.

THE QUEEN ACME ARC.

The Queen Acme Arc has also an exceedingly wide range. The lamps are differently adjusted, taking from 1.5 to 3.5 amperes and used in 110 and 220 volt direct current and alternating current work also.

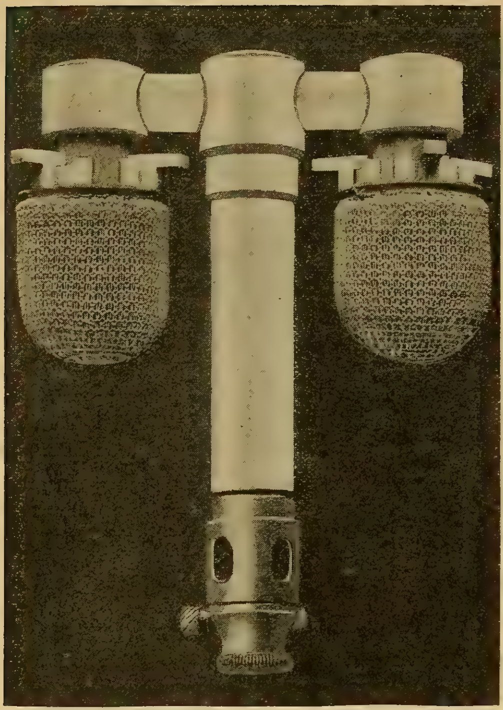
The cost of renewing the carbons is about the same as the cost of the renewals of the ordinary incandescent lamps of the number replaced by the arc; thus in a couple of months the lamp has paid for itself in the current saved and thereafter is earning money for the owner.

The trimming is so simple that it can be done by any man, woman or child of average intelligence. Carbons burn 28 to 30 hours on one trimming, thus making but one trim a week to an average burning of five hours a night.

Its remarkably steady, pure white light, resembling daylight, renders it indispensible to textile mills, color printing plants, retail stores and all other places where true color values are to be maintained. Its handsome appearance adapts the Queen Acme Arc equally as well to hotels, shop windows, ball rooms, public buildings, etc.

## A Really New Inverted Incandescent Gas Lamp

Since the trick of making an incandescent gas burner operate upside down was first discovered in Europe, there has been a continuous production of new designs and arrangements of the inverted burner. It would seem that every possible variation of the principle had been worked out, yet the new designs keep on appearing with unabated regularity. Which one will prove to fulfill the law of the survival of the fittest remains to be seen.



One possessing very decidedly novel features has recently been put on the market under the name of the "Rector Inverted Lamp." This ingenious device seems to have reduced the principle of the inverted burner to its lowest terms. The general principle on which it is constructed is shown in the accompanying cut. It consists merely of the ordinary Bunsen tube, having a means of adjusting the flow of gas, the top of which branches into two or more arms which support the mantles. The upright tube and supporting arms are made of a heat-resisting clay and are formed in a single piece. The entire burner, therefore, not counting the mantles, consists of but two pieces—the brass mixer which attaches to the gas pipe, and the Kaolin tube and supporting arms, which hold the mantles. The following claims are made for this new burner by its manufacturers:

It will burn on any pressure, will turn down to any point and not carbonize. It will use one or several mantles, will set in open flame glassware and look decorative. It will produce more candle power per cubic foot than any other gas lamp.

Results of test made by the Electrical Testing Laboratories:

The lamp was adjusted to a gas consumption of 9 cubic feet per hour at a pressure of 1.7 inches water. It was so located as to permit of measurement of a maximum candle power at each angle stated below.

No corrections have been made for variations from standard atmospheric pressure. City gas from the street mains was used. The mantles subjected to test were new, but were burned at least 15 minutes before photometric test was made.

RESULTS OF TEST.

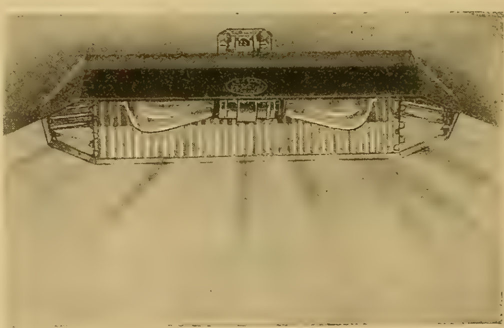
| Angle in vert. pl. | Pressure. Inches water. | Cubic feet per our. | Candle power. | C. P. per cubic ft. per hour. |
|---|---|---|---|---|
| 90° (Horiz.) | 1.7 | 9 | 210 | 23.4 |
| 45° | 1.7 | 9 | 245 | 27.2 |
| 0° (Nadir) | 1.7 | 9 | 190 | 21.1 |

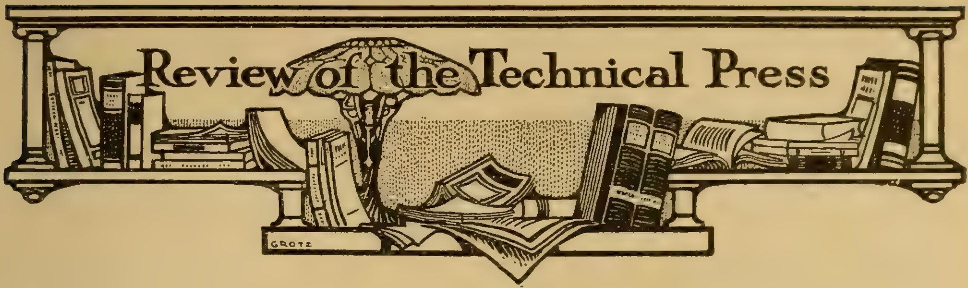
When burned at 0.1 inch pressure, a blue bunsen flame was produced.

## A New Line of Reflectors

The position of the mirror-lined metal reflector in the field of illuminating engineering devices is too well established to require any general argument. There are many cases in which a perfectly opaque reflector is required, and in such cases the construction utilizing the high reflective power of silvered glass, cut into sections to reduce the liability of mechanical breakage, and protected by a metallic support, is the best that has yet been devised. The linear form of such reflectors, commonly called trough reflectors, is invaluable for show window lighting and many other special problems.

A step in advance in this particular line has been taken by I. P. Frink, in bringing out several new forms adapted to the latest requirements of illuminating engineering. One of these, which will especially commend itself, is shown in the cut below.






# American Items

PROBLEMS IN ILLUMINATION MADE EASY, by W. R. Bonham, *Western Electrician.*

The article is an "attempt to simplify methods and formulas so that by the use of mathematics not higher than multiplication or division, any practical problem can be solved." The writer gives the following table of the illumination required for the different classes of service:

| | Foot-candles. |
|---|---|
| General illumination of— | |
| Auditoriums | 1 to 3 |
| Theatres | 1 to 3 |
| Churches | 3 to 4 |
| Reading | 1 to 3 |
| General illumination of residences | 1 to 2 |
| Desk illumination | 2 to 5 |
| Postal service | 2 to 5 |
| Bookkeeping | 3 to 5 |
| Stores, general illumination | 2 to 5 |
| Stores, clothing | 4 to 7 |
| Drafting | 5 to 10 |
| Engraving | 5 to 10 |

A table of the co-efficients of reflection of different colored wall papers is also given, as well as a table for calculating the illumination for various angles and heights of light-sources; a table showing the candle power delivered at different angles by various types of lamps, and a table for use in calculating street illumination.

For those who have only occasional need to make calculations of illumination, tables are a convenience, but for the practicing engineer who must be constantly making such calculations, the Macbeth calculator, which has recently been brought out, and which adapts the well-known slide rule principle to the computations, offers by far the quicker and more universal method.

A NEW, GRAPHIC METHOD FOR DETERMINING THE MEAN SPHERICAL INTENSITY OF A LAMP BY THE LENGTH OF A STRAIGHT LINE, by A. E. Kennelly, *Electrical World.*

An elaborate mathematical dissertation in which the mean spherical candle power is represented by a straight line instead of an area, as in the Rousseau method. As a mathematical stunt the article compels admiration, but as a practical method for the use of illuminating engineers, it seems to be devoid of merit. It is possible to obtain the sum of two and two by the use of the calculus, but the old method of simple addition is preferred by most of those who have occasion to require the result. In actual practice, the mean spherical candle power can be obtained from the simple diagram shown and explained in the last issue of THE ILLUMINATING ENGINEER, by the simple addition of ten different quantities and the decimal division of the sum.

SHOW WINDOW ILLUMINATION, by John E. Hardy, *Merchants' Record and Show Window,* illustrated.

After giving various specific directions as to the best method of window lighting, the writer says: "Electric lighting affords the window decorator a limitless field in which to exhibit his skill, and he should bear in mind that *the successful advertiser makes an ad. worth reading and a window display worth seeing.*"

ILLUMINATING ENGINEERING, by H. Thurston Owens, *American Gas Light Journal.*

A short report of the meeting of the Electrical Engineering Society of Columbia University, held March 6, which was

devoted to a discussion of illuminating engineering.

THE RATING OF GAS. (Editorial). *Engineering Record.*

Takes the position that the rate of gas by its candle power, and especially by direct comparison with the so-called English candle, is illogical, in view of the present methods of using gas for both light and heat. It says:

The gas companies of this country have suffered long from the survival of the ancient laws made before the introduction of mantle burners and gas engines, and the time is ripe for a change. The statute books of practically all the States which have any regulations regarding gas contain candle-power specifications based on a flat-flame burner and the old English sperm candle. This standard has long been discredited in the country of its birth, and has never at any time been satisfactory in precision. Candles give all sorts of irregular results, even in the most careful hands, and in England have been discarded in favor of the 10 c.p. pentane standard which practically represents a conventional average of candles based on the experiments of many years. It is widely used in this country as the practical standard, but the candle itself, with all its imperfections, still has legal force. To-day, however, so large a proportion of gas is used in mantle burners and for power purposes that from a practical standpoint the candle has lost most of the significance that might still attach to it. The ordinary consumer with an eye to economy uses gas in mantle burners, and for such use its putative candle power has little significance. The real value of the gas lies in its thermal value and the old light specification is really a discrimination against modern methods in favor of those which are a decade or two behind the times.

MUNICIPAL LIGHTING IN CALIFORNIA. *Municipal Journal and Engineer.*

Gives the synopsis of a report in regard to municipal lighting plants in the smaller cities of California, made to the Board of Trustees of Placerville, Cal. The general conclusion is as follows:

On account of the high cost of fuel on the Pacific Coast, steam plants are not generally successful there; it is only where fuel oil can be had cheaply and continuously that a steam plant is practicable. Many of the smaller cities which have municipal distribution of electricity for lighting and power buy the current from some of the large power companies. Water power is available here, and to such condition only was our inquiry directed.

The report includes the investigation of ten of the smaller cities and towns which have their own municipal plant or distributing system. Seven out of the ten cases investigated showed a profit.

ELECTRIC LIGHTING EXPANSION. (Editorial). *Electrical World.*

States that the gain in central stations for the year is 485, and the total number at the present time 5498.

ILLUMINATING ENGINEERING. (Editorial). *Electrical Age.*

Takes the position that the illuminating engineer is a needless specialist and that the work should be done by the architect. lamp.

CENTRAL STATION LIGHT, HEAT AND POWER PRINCIPLES, by Newton Harrison, *The Central Station.*

The present article in the series that has been running under this title deals with the question of lamps as related to central station principles, discussing the relations of the efficiency of the different sorts.

WORKING STANDARDS OF LIGHT AND THEIR USE IN THE PHOTOMETRY OF GAS, by Charles O. Bond, *Journal of the Franklin Institute.*

A very complete study of this much-discussed subject.

NEW COOPER-HEWITT MERCURY LAMP, by F. H. von Keller, *Electrical World.*

An illustrated description of the new automatic tilting mercury vapor lamp manufactured by the Cooper-Hewitt Electric Company.

ELECTRICITY VS. GAS LIGHTING. (Editorial). *Central Station.*

THE COMMERCIAL EFFECT OF BRIGHT LIGHTS. (Editorial.) *Central Station.*

# Foreign Items

By J. S. Dow.

Illumination.

The recently published reports of the Government Commissioners on lighthouse administration and the National Physical Laboratory are of considerable interest.

That dealing with lighthouse administration is mainly concerned with the question of whether or no it is desirable to bring the three distinct boards existing at present, which are responsible for the coast illumination of England and Wales, Scotland and Ireland, respectively, under one central authority. It has, however, been shown that the present arrangements work fairly satisfactorily and therefore no radical change is proposed, but only a few modifications designed to facilitate co-operation between the different authorities.

Many interesting points connected with illumination, however, arise in the course of the evidence given before the Commissioner which suggest that international co-operation between the lighthouse authorities would be of great value. For instance, there seemed to be some uncertainty about the actual method of testing the intensity of the system of illumination used, and it was suggested that the methods employed in France and England were not identical. In view of the many varieties of illuminants used—gas, oil, electricity and acetylene—and the immense annual expenditure of money in the maintenance of coast lighting by different countries, a greater degree of official co-operation is certainly desirable.

On the whole one cannot but be struck by the wideness of the whole question and the many problems of photometry and illumination that must arise therein.

The report of the Treasury Committee on the future work of the National Physical Laboratory is again indirectly of considerable interest to those concerned with illumination, if only on account of the important work to be done at the institution in connection with photometric standards.

Some fear has been expressed in this country lest the laboratory should tend to undertake tests of a purely routine character and so compete with private testing firms. The evidence on this point makes it quite clear that there has been little actual intereference so far; it was only feared that as the scope of the work of the laboratory increased competition of this nature might arise.

It has now been clearly laid down that the laboratory is at liberty to undertake "investigatory testing," but to refrain from carrying out purely routine work. Naturally it is difficult to draw hard and fast lines in matters of this kind, but we may be sure that the National Physical Laboratory will carry out the spirit of the recommendation of the committee.

The report of the past year's work of the laboratory is also available. A number of like tests have been carried out in connection with the work of the Engineering Students' Committee, and a series of incandescent sub-standards prepared for testing purposes. A new set of these, running at 2 and 2.8 watts per C. P., are to be prepared during the present year for use in testing metallic filament lamps The Violle standard is also to be investigated in accordance with the recommendations of the International Photometrical Commission at Zurich last July.

Mr. W. H. Y. Webber contributes a few remarks on the subject of the comparison of lighting effects in street-illumination. He refers briefly to the part played by the polar curve of distribution of a source in affecting the evenness of illumination secured from it, and also to the difficulty of adequately gauging the usefulness of this illumination by the existing method of testing. A considerable amount of discussion has recently been raging round this point in the technical press, chiefly referring to the question of whether or no the illumination should be measured in a horizontal plane. Mr. Webber emphasizes the view that in any case mere measurements of "candle-feet" can only be regarded as an index, and by no means finally settle the question of whether the illumination is all that can be desired. The existing methods of calculating the theoretical illumination by the inverse square-law may also prove misleading, while even actual measurements on the spot presents many difficulties. Still less can photographs be said to represent the actual state of affairs correctly.

An article in the *Electrotechnischer Anzeiger* (March 12), discusses the relative merits of direct and indirect illumination. After summarizing the main advantages of both methods, a numerical example is given. The writer concludes that indirect illumination may answer best in cases in which the height of the room is not more than 4 metres, otherwise direct illumination is preferable.

Paulsus (E. T. Z., Feb. 20), describes the efficiency-meter of Hyde and Brooks and also the watt-photometer of the Everett & Edgcumbe type. He also gives the results

of some of his own tests on the latter, in which the actual readings on the instrument are compared with the actual values of the illumination tested by "precision-photometry."

### Electric Lighting.

A paper of great scientific interest was recently read by Dr. Karl Sartori in Vienna (*Elektrot. u. Masch.*, March 22), which discussed the oft-raised question of how far the better efficiency of the metallic filament lamps can be ascribed to higher temperature, whether, indeed, the temperature of the carbon lamps is actually higher than that of the metallic filament lamp at all.

Dr. Sartori prefaced the subject proper of his paper by a general description of the nature of the radiation of solids. In particular he drew attention to the fact that the eye is most sensitive to the yellow-green region of the spectrum lying between the "D" and "E" lines, and that this seems to be a natural consequence of the fact that the energy-maximum of sunlight, rightly studied, proves to occur in this region also. We must, therefore, try to increase the temperature of radiation of our source of light so as to bring the energy-maximum nearer to this point. To actually reach this point would require a temperature of approximately 6000 degrees. In the case of glow lamps we are naturally unable to improve the efficiency by adding a linear spectrum, for this variety of luminous radiation is not characteristic of incandescing solids.

In general the energy-maximum of a solid incandescent body which can be regarded as "black," can be predicted when once we know the temperature of incandescence by means of the Law of Wien, which states that X T = Constant, where in the wavelength corresponding to the position of the energy-maximum and T the absolute temperature of incandescence. It is, however, possible for a solid body to deviate from the black-body law and prefer to radiate certain kinds of energy. In that case it is said to exercise "selective radiation" and does not then obey the law of Wien. Thus it is possible for the temperature of a filament to be lower than the position of its energy-maximum would suggest.

Dr. Sartori then goes on to describe some experiments of his own on this point. He studied the position of the energy-maximum of the grating spectra both of a metallic filament lamp running at 1 watt per C. P. and a carbon filament lamp taking 3.5 watts per C. P. and found that the maximum was situated nearer the violet end of the spectrum in the case of the carbon filament lamp. This would lead one to suppose that the temperature of the latter was the higher in spite of the greater efficiency of the carbon lamp. Much difference of opinion on this point evidently still exists. Professor Grau mentioned that Dr. Lummer had estimated the temperature of the carbon lamp to be about 2100 degrees C., but actually bolometric measurements of Pringsheim and Kurlbaum had placed the value nearer 1600 to 1800 degrees C., and the law of Wien therefore seems not to hold. It is still generally supposed that the higher efficiency of the metallic filament lamp is merely to be ascribed to higher temperature; there are, however, others who have been led to the same result as Dr. Sartori. Drs. Blau and Lombardi, for instance, assigned a temperature of about 1460 degrees C. to the osmiun lamp.

An informal address on the subject of incandescent lamps was also recently delivered to the Electrical Contractors' Association in London, by Mr. Leon Gaster. He dealt with the merits and disadvantages of the new lamps, and described the recent progress in their manufacture. The value of small step-down transformers for reducing the supply pressure also came in for discussion, Mr. Gaster urging the contractors to consider each case brought before them on its merits and not to run any risk of doing harm to the industry by recommending the metallic filament lamps indiscriminately. Small transformers for metallic filament lamps also forms the subject of a recent illustrated article in *Electrical Engineering*, a number of the chief makes being described.

A very complete history of recent progress in all details of glow lamp manufacture occurs in recent numbers of the *Zeitschrift fur Beleuchtungswesen* (Feb. 29, March 10 and 20); references to the most important patents on the subject are given.

A new form of inclosed flame arc lamp has recently been brought out in England by the Jandus Arc Lamp Company. One of the chief points in the lamp is the specially designed system of ventilation by means of which, it is claimed, the deposition of fumes on the interior of the globe and mechanism is entirely avoided.

### Gas, Oil and Acetylene Lighting.

Mention may next be made of some recent lectures by Prof. Vivian Lewes. The first of these dealt with the theory of the incandescent mantle (see *J. G. L.*, March 3), The lecturer summarized the history of the incandescent mantle in a popular manner, prefacing his lecture with a few remarks on the development of gas-burners in general, as illustrated by the work of Wenham and others. Naturally the existence of the incandescent mantle demanded a convenient form of high-temperature flame, and no progress could be made until the arrival of

the Bunsen burner about 1852. Previously a genuine incandescent light had existed in the limelight which dates from 1826. A basket of magnesium rods heated to incandescence in the burner flame was brought out in 1882, but nothing great was done until the eventual solution of the difficulties of the mantle by Welsbach's mixture of 1 per cent. of ceruum with 99 per cent. of thorium. It is, however, still a mystery exactly why this particular proportion of these two substances should be essential. Here the lecturer mentioned a few of the various theories still in the field, the catalytic theory, the theory of luminescence. One fact against the theory of high temperature pure and simple was the fact that the mantle would continue to glow a short time after the flame was turned out. This was illustrated by experiment. Finally some of the details were given of the various methods of forming the mesh of the mantle, mention being made of the recent Plaissety process.

Professor Lewes has also been delivering the Cantor lecture before the Society of Arts. While dealing mainly with the question of fuel, these lectures contain many points of great interest in the generation of illuminating gas. The most recent lecture, for instance, brought out the difference between the nature of products obtained by distillation at high and low temperature. In the latter case a smaller yield of gas is obtained but it is of a higher illuminating power and calorific value. The by-products are also such as to lead the lecturer to suggest that it might pay the gas producer to adopt low temperature distillation in preference to the present system.

Mr. Thomas Newbigging, has recently spoken on the question of illuminating values. Now that the incandescent mantle is becoming more and more universally employed, gas-engineers are anxious to obtain a calorific basis of testing as soon as possible and meanwhile are tempted to reduce the illuminating power, especially in cases where the great majority of consumers have been converted to the incandescent system. Mr. Newbigging, however, intimated that the time was not yet ripe for any violent changes, the vast majority of consumers were still chiefly interested in the illuminating power of the gas they bought, and any attempt to hurry matters might prove of doubtful benefit to the industry as a whole.

Dr. Rideal has published the results of a series of investigations into the hygienic value of gas and electricity as illuminants. In these experiments a room was divided into two similar sections illuminated by gas and electricity, respectively. An attempt was then made to compare the various phenomena which might be expected to be injurious to health. Among such effects we may mention the effect of carbon dioxide and other gaseous substances given off by gas. The main conclusion drawn by Dr. Rideal from these experiments seems to be that neither illuminants could be said to show any very distinct signs of prejudicial action. The conditions under which the experiments were undertaken, however, precluded the intentional production of very adverse circumstances.

A discussion between the junior members of the institutions of gas and electrical engineers on the merits of gas and electricity for lighting took place in Manchester last month. While the discussion did not, perhaps, elucidate any very novel points, it was at least notable as an instance of a growing feeling of toleration between the representatives of the rival systems of illumination.

Stephenson (J. G. L., March 10) describes a system of automatic control of street lighting; this system involves the lighting and extinguishing of street lamps by means of regulated waves of pressure in the town mains. The method is said to have worked very satisfactorily and to have led to a considerable saving both in attendance and in reduction of breakages of mantle, etc. No irregularities of the mechanism have been experienced. The only cause of trouble has been the occasional extinguishing of pilot-flames by wind, against which, of course, every system of automatic control has to contend. This merely calls for the use of suitably designed lanterns.

It has been suggested that consumers might resent the temporary change in the light in one and a half minutes during which the wave of pressure was in use; actually, however, no complaints were received. Indeed, we are told that in some instances the voluntary intimation that midnight had arrived was regarded as a convenience!

Present number of the *Zeitschrift fur Beleuchtungswesen* have contained an exhaustive description of newer forms of burners for inverted incandescent mantles, which is accompanied by references to the recent patents on the subject.

### Miscellaneous.

Grau and Russ (*Physikalische Zeitschrift*, Feb. 1) describe some experiments on arcs formed between cooled metallic electrodes. Their object was to ascertain how far Mrs. Ayrton's results were applicable to these conditions. This had already been done by Guys and Zebrikoff, but their experiments were confined to short arcs; the authors extend their investigations to arcs of 40 to 50 millimeters in length, with the result that they, too, find that Mrs. Ayrton's results apply.

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THE INTERNATIONAL ELECTROTECHNICAL COMMISSION.

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THE PRESERVATION OF THE EYESIGHT IN CHILDREN, by H. E. Biss.

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THE STANDARDIZATION OF COLORED GLASSES APPLIED TO ILLUMINATED SIGNALS BY NIGHT, by Aug. Pihan.

SUGGESTIONS AS TO HOW THE ARCHITECT AND THE ENGINEER MAY COMBINE, by Percy J. Waldram.

THE TUNGSTEN LAMP, by A. Grau.

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* *Abbreviations used:*
*E. T. Z.* *Elektritechnische Zeitschrift.*
*Elek. Anz.* *Elektrotechnischer Anzeiger.*
*Elektrot. p. Masch.* *Elektrotechnik und Maschinenbau.*
*G. W.* *Gas World.*
*J. G. L.* *Journal of Gas Lighting.*
*J. f. G.* *Journal für Gasbeleuchtung und Wasserversorgung.*
*Z. f. Bel.* *Zeitschrift für Beleuchtungswesen.*

# Miscellaneous News

ALBANY, N. Y.—The Public Service Commission in the second district announces that according to the reports of its inspectors, who have made investigations in various parts of the State, there is at present a marked improvement over the quality of gas supplied a year ago.

"During the last six months," says a statement made public to-night by the commission, "out of 180 inspections made in every part of the state, 112 companies were found to be supplying gas equal or superior to the standards fixed. There were, however, forty-one case of deficiencies in candle-power. Hydrogen sulphide was found present in twenty-six tests and ammonia or sulphur in excessive quantities in twenty-two tests. Satisfactory explanations were offered by the offending companies and proper steps taken in each instance to avoid a recurrence."

BALTIMORE, MD.—The directors of the Duquesne Light & Electric Company, of Duquesne, Pa., have elected Mr. George R. Webb, of this city, president of the corporation.

Mr. Webb succeeds Mr. R. C. Hall, who becomes vice-president. It is said that the company contemplates spending $4,500,000 in improvements, including a new central power plant. The capital of the company is $500,000, with authority to issue bonds to the extent of $10,000,000.

CHICAGO, ILL.—The measure, which has been pending before the council for over two years, legalizes the consolidation of the Commonwealth Electric and Chicago Edison companies, and fixes the maximum rates to be charged by the new corporation during the next four years.

It provides for a compensation of 3 per cent. on gross receipts during the thirty-eight years of the life of the franchise held by the Commonwealth Company, which is extended to include all of the subsidiary corporations.

The ordinance legalizes the consolidation of the Commonwealth Electric and Chicago Edison companies as the Commonwealth Edison Company, gives the new company the same length of franchise as the Commonwealth corporation, which still has thirty-eight years to run. It provides for an annual compensation of 3 per cent. on the entire business of the corporation, which is estimated at $600,000 a year.

The maximum rates fixed by the ordinance until July 31, 1912, follow:

Primary rates for light, heat and power current, 15 cents per kilowatt hour, to July 31, 1908; 13 cents after that date.

Secondary rates for light, heat and power current, 9 cents to July 31, 1908; 8 cents to July 31, 1909; 7 cents after July 31, 1909.

Primary rates for power current alone, 11 cents.

Secondary rates for power current alone, 6 cents.

Arc lights for city use, $75 per year.

KANSAS CITY, MO.—The electric light franchise contract presented to Kansas City, Kan., fixes the price of electric lights in that city for a period of thirty years at the same rates now charged in Kansas City, Mo. The investigation made by the Mercantile Club revealed the fact that the people of Kansas City are paying *at least* 30 per cent. more for lighting with electricity than they should pay, and still allow the company a wide margin for "velvet" above the cost of production.

The business men and the citizens of Kansas City, Kan., have recommended to the city council, therefore, that the franchise be rejected until the electric light company reduces its rates.

NEWARK, N. J.—To bid for business in Jersey City and adjacent towns at first, and afterward in other parts of the State, the Mutual Benefit Electric Light & Power Company has filed articles of incorporation with the county clerk of Hudson County with a capital of $2,500,000. The incorporators are James M. Seymour, president of the Block

Lighting Company, of this city; Jean R. Nagel, of Jersey City. The new company will also offer to establish lighting plants in municipalities, agree to sell current at a uniform and low rate for twenty years, and then turn the plant over to the municipality at an appraised value of its machinery in its then condition.

ST. LOUIS.—Figures compiled at the City Comptroller's office show that St. Louis pays each year to public service corporations for public lighting in excess of $600,000. This includes lighting of public buildings and streets.

In addition to this the city has its own lighting plants at the City Hall, the Industrial School, the Quarantine Hospital and the Waterworks Station at Bissell's Point. The cost of operation of the plant at the City Hall for the past year was $10,774. The operating expenses of the other municipal plants are not available.

The city's lighting contracts are with the Union Electric Light & Power Company for electricity, and the Welsbach Company of America for gas. Both contracts are controlled by the North American Company.

An electric lighting plant owned by the city could light the streets and city buildings at a handsome saving, in the opinion of Harry Sanderson, superintendent of city lighting.

He is not in favor of the city building a plant only to light the streets and city buildings. It would cost too much for the benefits that would result.

Mr. Sanderson has calculated that the city could build a plant for $5,000,000 that would light all the streets and alleys and public buildings and would supply all the current needed by private citizens for light and power within a district bounded by Freeman avenue, Arsenal street, Jefferson avenue and the river.

SAN FRANCISCO, CAL.—A test of the comparative merits of arc lamps and clusters of incandescent lights for street lighting was made last night on the block on Geary street, between Kearny street and Grant avenue, in the presence of members of the Board of Supervisors, the Permanent Down Town Association, interested property owners and real estate men. The lights were alternated at brief intervals, while the general effect and different quality of light were carefully noted.

Electrical engineers formed a group in which were Chief Electrician Hewitt of the Department of Electricity and Secretary King of the Merchants' Association. While no definite conclusion was reached, yet the consensus of opinion seemed to be in favor of the arc lamps.

Temporary poles had been erected ninety feet apart opposite one another on both sides of the street. The arc lights were placed on top of each pole, at a height of twenty-one feet, and beneath them were grouped six incandescent lights of 32 candle-power and a high voltage. Electrical experts agreed that the incandescent lights were not successfully grouped, because they were a little too far from the center.

One-half of the groups were furnished with sanded glass globes, while the other half had bell shaped fluted glass covers, the former giving a softer and more evenly diffused light, while the latter threw out a more glaring light upon the street. The incandescents were favored for their appearance and their soft yet bright light, which came down low, while the arc light was more evenly diffused, if a little too high up from the street. Ten poles being in the block there were ten arcs and sixty incandescents.

The question of cost of maintenance was discussed, and the result was in favor of the arcs, although the incandescents were more generally admired. As the plan contemplates using the poles for trolleys wherever trolleys are used, the electrical experts agreed that incandescent lamps would not be practicable, owing to jarring and consequent destruction of films in the globes.

A modification for arcs was suggested by providing a slightly lower pole with a crook on top from which the arc lamp would hang. With either system of illumination the street was brilliant with an abundance of light which was never before seen in this city.

The plan for lighting contemplates erection of the poles by the Down Town Association and their maintenance by the city in many streets.

TOPEKA, KAS.—By a vote of 29 to 3 the Topeka Commercial Club went on record at a special meeting as favoring a proposition made by the Topeka Edison Company for illuminating the streets of the city and opposing the plan to vote bonds for a city lighting plant at the approaching election.

The proposition which the Edison company made, in essence, was that it would furnish for $50 per lamp per year 400 or more magnetite, 4-ampere, 75 or 80-volt street lights, all night and every night service, for a period of ten years. The city would be required to give the Edison Company the use of its present poles and wires, the company to make the necessary renewals, improvements and extensions at its own cost. At the end of the period mentioned the company would turn over to the city the then existing pole lines and wires at the actual cost of the renewals, betterments and extensions, less the depreciation, the depreciation to be fixed by a board of three appraisers.

The

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## *Contents of This Issue.*





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# "Get Together"

*A convention is, in the literal meaning of the word, a coming together. Specifically, it is the coming together of those who have common interests and similar purposes in life. There is perhaps no other word, nor any other institution, which comes nearer expressing the keynote of modern commercial life.*

*Man has subjugated the earth solely as a result of concerted action and co-operation. The aborigines expended their energies in mutual warfare; they are on the verge of extinction at the hands of a physically weaker race who worked and dwelt in peace and harmony.*

*America has learned the value of co-operation and profited by its application to a greater extent than any nation within the records of history, and her future greatness will be proportional to the extent to which a wise and just combination of the varied elements of personality, physical resources and diversity of opinions, is fostered and consummated.*

*Personal association on terms of mutual equality and on the basis of common interests is the one infallible antidote for distrust, misunderstanding, and those business methods that are injurious in practice, and pernicious in ethics. The unkind thought, the sharp scheme, and the illegitimate business stratagem cannot withstand the broadening view and generous feeling which inevitably spring from personal association. The mutual exchange of ideas is as fatal to unjust and ungenerous impulses and small meanness as is sunlight to the miasmas that are engendered by darkness.*

*"There is no sentiment in business;" preposterous falsehood! In nothing is sentiment so vital a factor. What conditions are essentially different in this country to-day from those that existed a year ago? Commercial activity and sentiment. The one is as necessarily the complement of the other as the night is of the day.*

*The people have nothing to fear from co-operation. On the contrary, their most cherished ideals and principles can be attained in no other way.*

LET US GET TOGETHER; THERE IS ENCOURAGEMENT AND POWER IN THE SIMPLE AGGREGATION OF INDIVIDUALS.

E. L. Elliott.

FIG. I.

# The Greater and Brighter Atlantic City

By L. W. Byers.

Atlantic City—rolling surf—innumerable bathers—endless expanse of boardwalk—miriad lights—an ever-moving throng of people on pleasure bent: such are the visions which the name of this "City by the Sea" at once brings up. So inseparably connected are these ideas of the summer pleasure resort with Atlantic City that it will doubtless come in the nature of a surprise to the readers to learn that the city has a permanent population of over 40,000, and that this regular population is increasing as rapidly as in any other of our most prosperous cities.

It is quite natural that the greatest amount of attention should have been given to the embellishment of the city's most attractive feature—namely, the water front. A boardwalk in itself is no great novelty, but when a person speaks of "*the* boardwalk" there is no doubt at all as to which boardwalk he has reference to; it is the boardwalk in Atlantic City. Every self-respecting town has a Broadway, but no one would assume that the word "Broadway," when used alone, referred to any other street than a particular one in New York City. A letter sent from any part of the world, addressed to "John Smith, Board Walk, America," would, beyond doubt, be safely delivered into John's hands at Atlantic City.

The Broadway in New York City is in reality a narrow way, but the boardwalk at Atlantic City is really made of boards. It is 60 feet wide and 4 miles long, and is

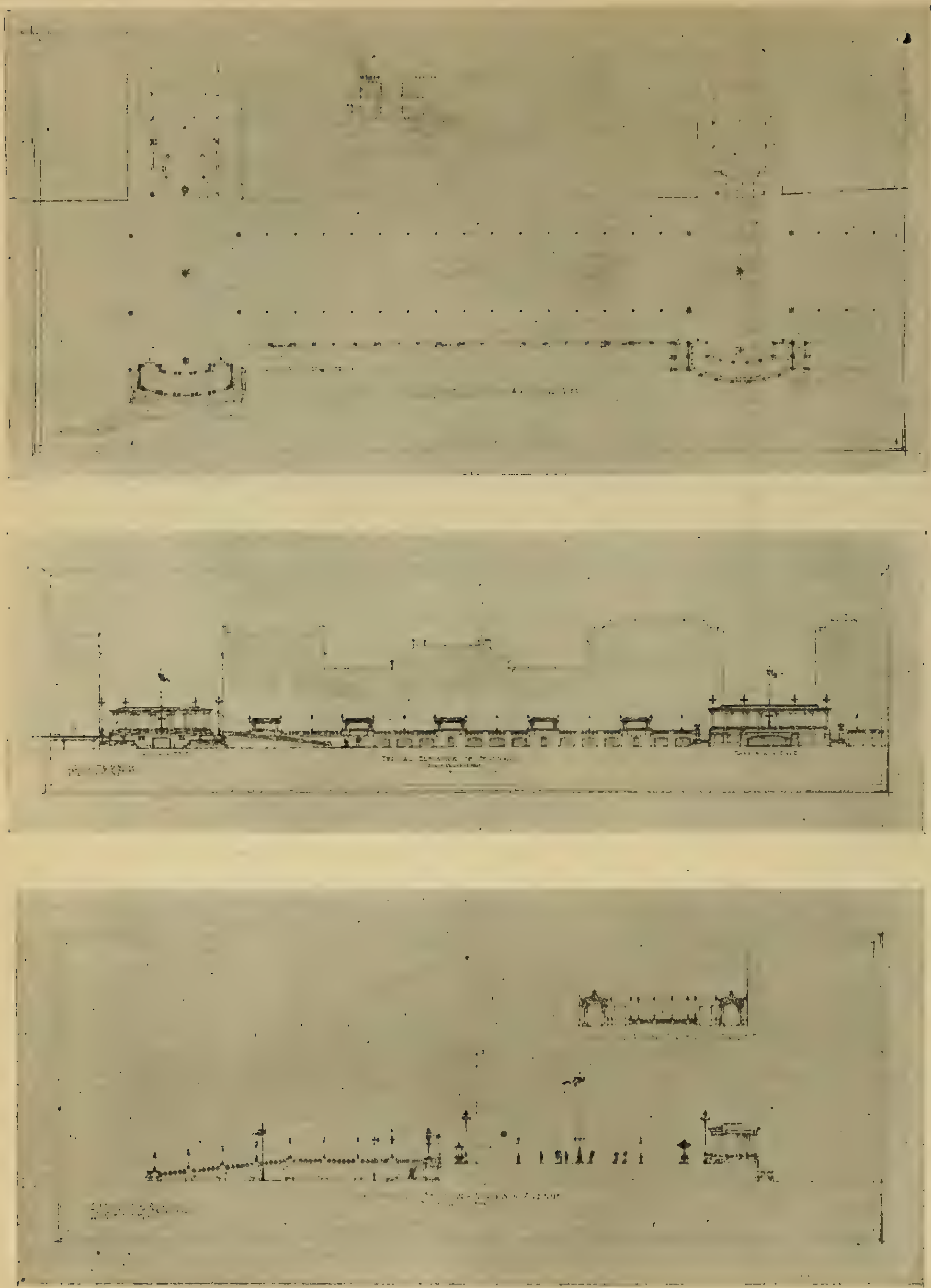


FIG. 2.

supported on piles driven into the sand of the beach. At a respectful distance back of this boardwalk are located the principal hotels; and immediately adjoining it is a line of bazaars and a miscellaneous collection of small shops which are irresistibly diverting to both the minds and pocketbooks of the passing throng. At in-

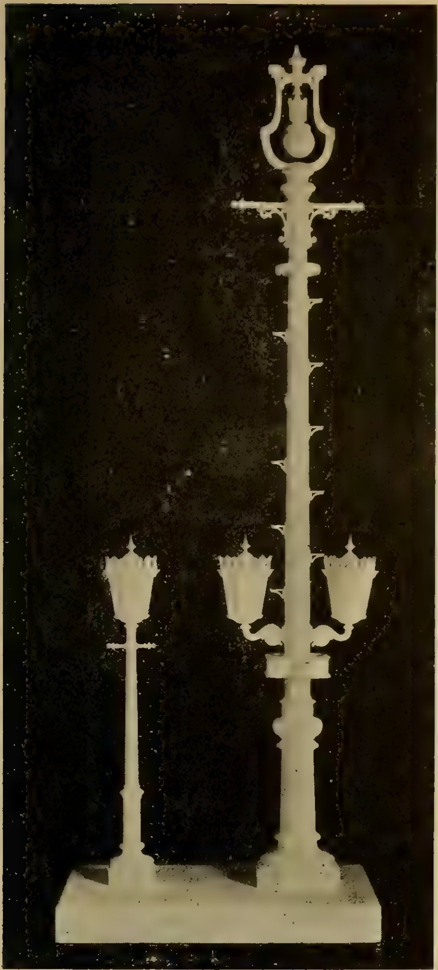


FIG. 3.

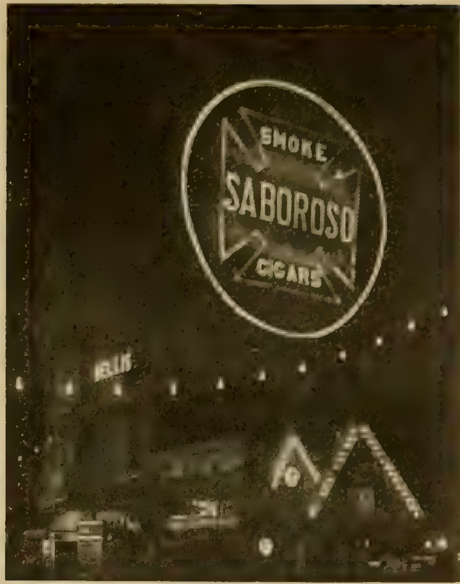



FIG. 4

tervals of half a mile, or such a matter, piers extend far out into the ocean.

Atlantic City is a palpable contradiction of the scriptural injunction against "building a city on the sands." The foundation of Atlantic City, literally and metaphorically, is its remarkable stretch of sandy beach, which slopes so gently that one may wade out almost out of sight of land without getting overhead in the water. This unsurpassed stretch of bathing beach, fronting the open sea, in a location blessed with a fairly equable climate, has attracted people from every section of the country, and particularly from that vast central section which is comparatively remote from the coast. The necessities for catering to the demands of this army of pleasure-seekers has given rise to the permanent and regular settlement which makes up the city.

Anything and everything which can add to the pleasure of a holiday, or enable the pilgrim to lay aside the burden of dull care even for an instant, has been studied out and utilized to make the ocean front, or, what means the same thing, "the boardwalk," attractive. As would naturally be expected, the most conspicuous among such devices is the lighting. To those who have been on the boardwalk by night any attempt at a description of the general effect of the lighting would be futile, but those who have never seen it can get some faint idea of the scene from the photograph reproduced on the front cover of this issue. The view shown, however, is only a comparatively short stretch of the walk, and shows the general scheme of lighting, which consists of lamp posts, carrying arc lamps, at regular intervals on either side of the walk, between which are festoons of incandescents. In front of the piers there are also festoons of incandescents across the walk. The pavilions on the piers are simply a blaze of light, while the numerous bazaars and shops are illuminated with every possible variety and scheme known to the art.

Anyone who has known Atlantic City for even a comparatively few years must have observed its constant development

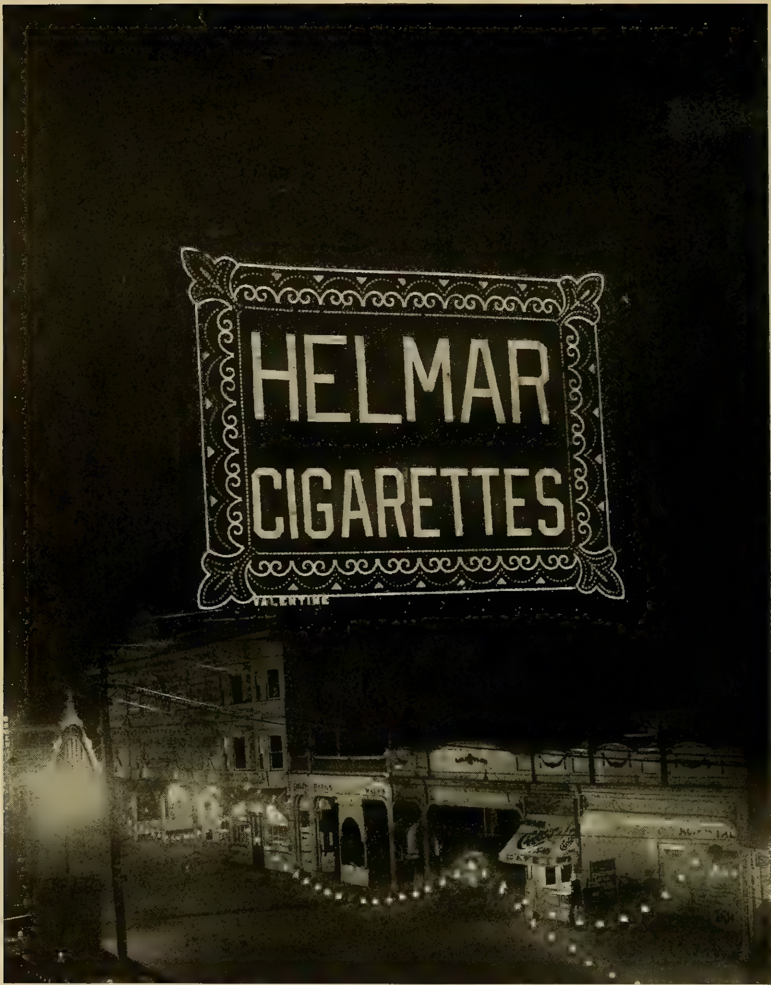



FIG. 5.

toward a more permanent and substantial character, and its tendency to abandon the essentially flimsy and temporary features which are more or less characteristic of all American summer resorts. This commendable tendency has, within the past two years, been taking a more definite and tangible form than has been known to the general public. As a result, a comprehensive and well-matured plan for the general beautification and improvement of the city has been worked out, and its actual execution begun.

The general scheme, which is far-reaching in its nature, and will require some years to complete, involves a general improvement of the streets and the establishment of parks and parkways.

It will be particularly interesting to illuminating engineers to know that the one feature which has been given, perhaps more than any other, serious consideration on the part of those who have had the matter in charge, is the question of lighting. The improvements planned involve not only the illumination of the boardwalk, but of the more prominent business streets of the town. The fact has been realized that about the best that could be said of the lighting of the boardwalk was, that there was lots of it. Its temporary, not to say makeshift, nature and appearance, no one would attempt to deny.

The general plan, which has been prepared by Carrère & Hastings, of New York City, provides for the widening of


FIG. 6.

the boardwalk by twenty feet on each side, this additional space being intended especially for pedestrians; to be sure, no horses are allowed on the walk, but, as an Irish friend suggests, the central portion may be reserved for foot-passengers.

In place of the plain poles serving as supports for the arc lamps, which are now in use, two kinds of lamp posts, of a dignified and ornamental character, will be used. The photograph reproduced in Fig. 1 was taken from the plaster models made from the architects' designs. The taller posts will be used at the four corners of the walk corresponding to the intersection of the avenues, while the smaller post will be used in the intervening spaces and along the line where the outer or added portion joins the present walk. Festoons of incandescents will be used between the posts, as at present. The taller post supports an arc lamp at the top. The lanterns lower down, and also those supported by the smaller posts, will be equipped with clusters for incandescents. The size and type of incandescent lamp has not yet been decided upon, but in any case, the lanterns will be so wired that the lamps may be used partly or all together, as desired.

The approaches to the walk from the principal avenues will be constructed of concrete and given especially artistic treatment, a fair idea of which is given by the architects' sketch shown in Fig. 2. A small observation pavilion of classic design is an essential feature of these approaches.

The Atlantic City Fathers have realized that its business streets have been wofully out of keeping with the one chief attraction, the boardwalk; and one of the most important features in the proposed scheme of improvements is the metamorphosis of at least one or two of these unattractive thoroughfares into thoroughly modern and attractive business streets. Atlantic and Pacific avenues will receive particular attention. On these streets the same design of lamp posts will be used as on the boardwalk, with this difference, that instead of four, only two of the tall posts will be used at diagonally opposite corners of intersecting streets, and the smaller posts along the intervening spaces.

Following the example set by some of the Western cities, the city hall will receive a generous treatment in outline light-

ing, somewhat on the lines indicated in Fig. 3.

There are two essentials to the prosperous business street—a good pavement and good lighting. It is as unreasonable to expect business to flourish under the old flickering gas jet, or the widely spaced arc lamp, as it is to expect customers to stumble along brick sidewalks or rattle over cobblestone pavements to find a place wherein to make their purchases. The very substantial recognition of the importance of good street-lighting which has been thus shown by the city authorities will unquestionably find a ready response in the individual efforts of the merchants and residents on these streets. Brilliantly and artistically lighted show-windows, tasteful electric signs, and a judicious use of outline lighting may be confidently expected to appear as a sequel to the improvement in the public lighting. Instead of making all possible purchases before starting for Atlantic City, it is by no means impossible to conceive that the time may soon come when the pleasure-seeker will have the advantages of an attractive and fully equipped center of trade in which to make any desired purchases, as an additional incentive to his visit. Combining business with pleasure is a habit with the American, and why should it not be fostered by the merchants and citizens of Atlantic City?

Four million people, more or less promenade the boardwalk in the course of a season, all, like the Athenians of old, anxious to see or hear some new thing. The boardwalk has the Atlantic Coast on one side and the Coast of Bohemia on the other. This Bohemian coast offers unusual advantages for the display of the electric sign, of which there are at least fifty-seven varieties within its confines. The electric sign has this advantage over the sermon: you can enjoy its beauty without being obliged to follow its advice. Thus, the sign shown in Fig. 4 is really an impressive sight, considered strictly as a piece of spectacular lighting. Likewise, the sign shown in Fig. 5 holds the attention by reason of its harmonious blend of colors—which of course do not show in the photograph—and its enormous size; it is 90 feet long and 60 feet high, and contains 3300 lamps. There is a certain fascination in mere bigness; what would the circus be without the elephant?

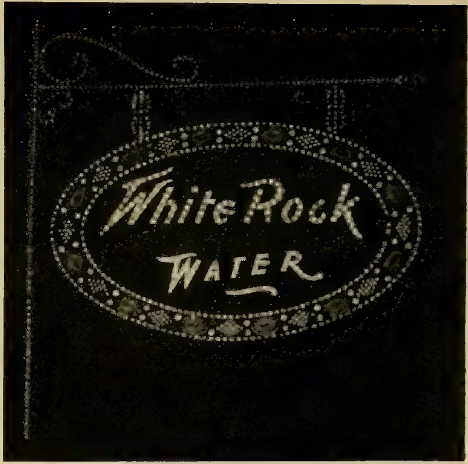
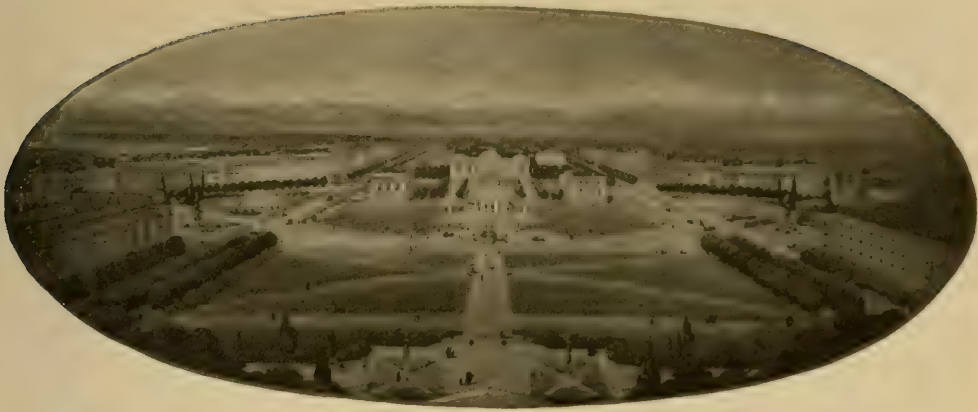



FIG. 7.

The growth in size and elaborateness of the electric sign is well illustrated in the three examples shown in Fig. 6. Please observe that these examples are shown for strictly scientific and historical reasons, and have no reference to the commodity which they advertise; but to make quite sure of this point and to demonstrate that the electric sign is strictly impartial and non-partisan, the example shown in Fig. 7 is inserted.

Admit that the electric sign is always commercial, not infrequently garish, generally obtrustive, and altogether aggressively conspicuous; yet if the electric signs along the boardwalk, or "The Great White Way," or the busiest part of your own beloved town, were all turned out, would it not leave a void which no other form of attraction, however conformable to esthetic notions, could fill? Let us, therefore, honestly express our real feelings toward it by the old toast, "May its shadow never grow less."



# Illumination of the Proposed Civic Center of Denver

By R. Garland Gentry.

R. GARLAND GENTRY.

While every American city is, and should be, a source of pride to its own inhabitants, there are particular cities, which, for one reason or another, hold an especially warm place in the hearts of all Americans. Among these Denver must undoubtedly be included.

Denver is, above all, picturesque. The history and circumstances of its foundation are picturesque; its location, in the foothills of the grandest mountain range on this continent, is picturesque; and it is with the special view of adding to this essential character of picturesqueness that the new civic center, or plaza, has been planned by its citizens. This plaza is to occupy a space of six city squares, having the capitol building at one end, and other public buildings suitably disposed about the other sides. One and a half millions of dollars will be expended upon the grounds and buildings.

A perspective view of the proposed plan is shown in the illustration above, and a sketch showing a night view of a section of the plaza is also reproduced.

Denver has assumed the title, "City of Light," but lest other cities may accuse Denver of taking Hamlet's advice, "Assume a virtue, if you have it not," it is intended to give especial attention to the illumination of this proposed civic center, which is to be the expression of Denver's idea of the "City Beautiful," as applied to its municipal buildings. When the scheme in its entirety shall have been consummated, it is believed the title may be claimed with all fairness and justice.

The following suggestions were made to the city authorities by the writer:

There are three fundamental principles to take into consideration in the illumination of the proposed plaza. First, from

an artistic point of view; second, an even distribution; and, third, a soft, well diffused illumination to produce the best general effect over the entire space under consideration.

I prefer a pole of modest proportions and conventional design equipped with incandescent lamps of some modern type such as Gem, Tantalum or Tungsten, giving a high rate candle power and a low wattage consumption per unit. Space these poles about 100 feet apart diagonally across the street or driveways, which will lend itself more readily to artistic effects than is possible to secure from the regular street arc lamps. These poles and fixtures will conform with other statues, figures, etc.

An even distribution can be secured from lights placed as above mentioned and is much more preferable than the old way of street lighting, which is not good illumination, due to the fact that it is impossible to obviate the shadows, and "spots" which are the result. Also the arc in passing around the carbon will give at an angle of about 25 degrees 600 candle power, while at the opposite side 200 candle power will be obtained. These and other objections make the incandescent units a better type for street or park illumination when it is prohibitive from a monetary standpoint to place the units more frequent on the surface to be illuminated.

A park or plaza such as this would be styled is a resting place, and therefore would naturally suggest a soft, easy, well diffused illumination for the restfulness of the optics. This could only be accomplished with incandescent units equipped with translucent globe of some familiar type of glassware which would answer sufficiently and give the desired results.

For spectacular display the outlining of the important buildings such as the stadium, mint, public library and others, to bring out the main architectural lines and faces, would give the desired effect both from an illumination and architectural point of view. Also there should be a large search light on the capitol dome, playing on the fountain alternating the different color effects by means of color slides.

For the sunken garden a similar effect could be worked out with different color schemes to blend with other effects.

This would give, for festival and special occasions, a splendid gala effect, and give the city of Denver something very unique and special, and which would make it even more worthy of the name "City of Lights."

# Lamp Posts: The Hotel Sign of New York

By H. Thurston Owens.

The European custom among hotels, of having a large sign with its name in a conspicuous place, has not been followed in the newer and more pretentious hostelries in New York. There is a feature of exterior decoration, however, which indicates in a most artistic manner that the building is a public one; this is found in the exterior lighting fixtures, which are usually lamp-posts.

The hotels erected here within the past decade represent investments of many millions of dollars, but not one has its name emblazoned before the world; practically all of them, however, have arrangements for exterior illumination.

The methods used among American hotels include posts along the curb or building line, bracket lamps, entrance standards and outline lighting, and the illuminants range from open flame gas to flaming arcs.

The advent of these ornamental lamps has done much to lend an air of cheerfulness and gaiety to many streets which have heretofore been commonplace, the hotels often remaining quiet and uninviting despite their changed outward appearance.

On one of the busiest thoroughfares within a block of Grand Central Depot, is located the Manhattan Hotel, Madison Avenue, northwest corner of Forty-second Street (see Fig. 1). The installation here consists of a large number of posts which form part of the railing at the building line. The enclosing globes are unique, in that they are of light blue art glass. The fixtures look as well by day as by night, for they are a part of the exterior decorations and very attractive.

The example set by the newcomers has been followed by the older ones, and these spectacular sentinels of welcome may be found at such conservative hotels as the Murray Hill and the Park Avenue, which are to the south and on Park Avenue.

FIG. 1.

FIG. 2.

FIG. 3.

The latter is shown in Fig. 2, and is located between Thirty-second and Thirty-third streets. The architectural feature of the building is found in the Corinthian columns over the entire façade. There are posts along the curb here, which have been recently installed, the design being fluted Corinthian columns. They are very heavy and massive in appearance and even their virtue of uniformity does not spare them from criticism as lighting fixtures. From their appearance they should be able to support a portion of the building as well as the lamp.

On Fifth Avenue there are comparatively few hotels, and with one exception none have posts along the curb.

The Holland House, on the corner of Fifth Avenue and Twenty-ninth Street, Fig. 3, has brackets at the entrance which are decidedly novel. Flying dragons support balls of fire by means of chains held in their mouths. The enclosing globes are of cut glass and frosted. They have the distinction of being unique, but can hardly be termed successful.

Just north is the Waldorf-Astoria, where lamps are to be found, and continuing, we pass Sherry's and Delmonico's, and then reach the Hotels Gotham and St. Regis, at Fifty-fifth Street, on the southwest and southeast corners, respectively. In both cases there are standards along the balcony, those at the Gotham being shown in Fig. 4. The examples shown here are rarely equaled, and, needless to say, the effect is very attractive and not at all spectacular.

It is but a step from here to the Plaza, one of the most attractive spots in the city. The square is small as compared with the Placé de la Concorde, and the illumination is not as extravagantly supplied.

The Hotel Plaza occupies the westerly side of the square and the Fifty-eighth Street side of the building is shown in Fig. 5. Beautiful bronze lanterns of clear glass have been erected on all three sides

FIG. 4.

FIG. 5 AND 6.

of the building and in addition the Fifth Avenue entrance and its balcony is illuminated by means of pendant frosted balls over the entrance and standards along the railing on the balcony above. The lower portion of the building is François the First, and the lanterns are of the same design.

Aside from the fact that the lanterns have clear glass sides, the effect is very pleasing, and in keeping with the hotel's reputation as one of the most attractive as well as the costliest of hotels.

Readers of THE ILLUMINATING ENGINEER will no doubt have noted the numerous descriptions of spectacular street lighting which have appeared from time to time. but there is one installation which has not been described; Fifth Avenue from Washington Arch to the Plaza, New York City. Although the installation is not a new one it is well worthy of consideration as an example of artistic and effective street lighting. The post used is shown in Fig. 6, the lamps being located 130 feet apart for a distance of two and one-half miles. The gas lamp shown is a Fire Alarm lamp, with red glass in lantern and equipped with alarm box.

On Broadway the conditions are different from any other street, for although the hotels are quite numerous, none are distinctly fashionable. As is well-known, the number of advertising signs outrank any similar street in the world, and this is also true of ornamental lamps.

Just north of Madison Square, is situated the Hotel Victoria, where massive posts with enclosed arcs are found along the curb, as shown in Fig. 7. A pleasing effect is not obtained here, as the lanterns have clear glass sides and the streaky light is far from attractive.

FIG. 7.

A few blocks north, at the Grand Hotel,

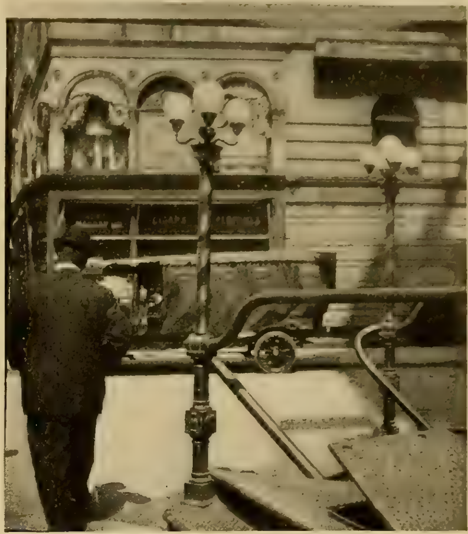


FIG. 8.

an enterprising barber has caught the spirit of the times by placing clusters of lamps in frosted globes at each entrance post, see Fig. 8, the post being painted red and white, as is customary.

FIG. 9

FIG. 9A.

Looking north from here, we find the most spectacular array of street lamps to be found in the city, which are in front of Hotel Imperial, shown in Fig. 9. Each post has a cluster of five frosted globes, and as their height and number are unusual the effect is most striking. The style of post and illuminant used for the regular city lighting is also shown here; these are D.C. multiple 450 watt, enclosed arcs, with opal inner and clear outer globes, on iron posts. One is placed at each corner on alternate sides of the street,

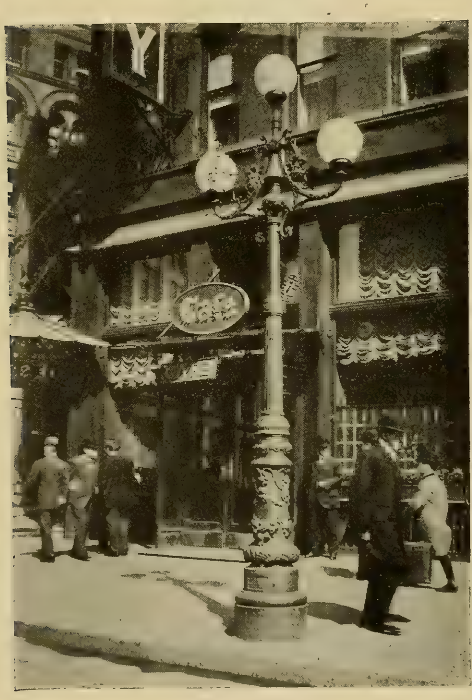


FIG. 10.

FIG. 11.

the blocks averaging 265 feet; so that the street would be well lighted if the additional private lighting was not supplied.

At Broadway between Thirty-sixth and Thirty-seventh streets, in front of Hotel Marlborough, is found a rather ineffective installation, for the posts are very unattractive, and there are not enough to make a display. Fig. 9A.

The Hotel Vendome was recently remodeled and rechristened Hotel Albany, one of the results being an array of spectacular posts as shown in Fig. 10.

A somewhat similar post is found on the next block, at Hotel Knickerbocker, where there are three lanterns on each post (see Fig. 11). The idea of placing two or three lanterns on each post is much in vogue in Europe, but has not found favor in this country.

An incandescent lamp in a clear glass lantern does not make an attractive combination, especially when the lantern sides are of small sections, as in the present instance; as novelties, however, they are decidedly effective.

Continuing north, we reach Rector's Restaurant, where a small, but novel, col-

FIG. 12.

FIG. 13.

lection of posts are to be found. These are shown in Fig. 12.

We are now at Times Square, the present northerly terminus of "The Great White Way," and on the west side is found the most artistic installation of exterior hotel illumination on record. The result is obtained by means of posts on building line, shown in Fig. 13, posts on balcony and posts around top floor, the equipment consisting of incandescents with dense opal enclosing globes. The success of this installation is rarely attained even by the elaborate examples found in Exposition work.

Prior to the formation of Greater New York, on January 1, 1898, it was necessary to obtain the consents of the "City Fathers," the Board of Aldermen, in order to erect lamp posts, and many resolutions have been passed for that purpose. Under the new charter, this power was relegated to the Commissioner of Water Supply, Gas and Electricity; permits are issued at his discretion, and the work done under the supervision of the lighting engineers in his department. These fixtures are installed and maintained by the owners, and the lighting hours are usually from dusk until midnight; the regular corporation lighting being provided for, entirely independent of these private installations.

The display of exterior lighting fixtures found in New York is not equaled in any other city, and an excellent opportunity is afforded to compare the various styles.

Among the numerous schemes of civic bodies for municipal improvements is the one of more attractive as well as more effective street lighting, and these installations are to a certain extent the forerunners of this movement.

# The "Great White Way" of Knoxville

By R. P. Williams.

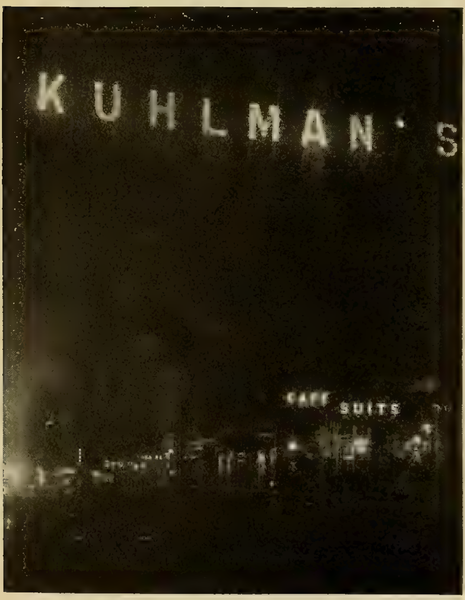
The stranger who enters the city of Knoxville at night cannot help being impressed with the effective quality of the illumination of Gay Street, the city's "great white way." In the half mile which he traverses on his way from the railroad station to his hotel, he cannot fail to note that ingenuity, originality, and a certain broad spirit of civic pride are manifest in this sure sign of a city's progress —the illumination of its streets and buildings. This fact becomes even more remarkable when it is known that it is only since the year 1905 that electric signs over sidewalks have been permitted by the city government of Knoxville, and that therefore practically all improvement and progress in the spectacular illumination of the city has been accomplished in the past three years.

Going south on Gay Street, at Commerce, one comes upon one of the most important signs in the city, stretching across the street—the sign Kuhlman's, advertising the principal drug company of the city. This same name is also repeated in a large vertical sign on their store.

"Have You Seen Smith?"—the question is blazed out at you, and of course you find yourself unconsciously asking, "*Who* and *what* is Smith?" Smith, you are informed, is the leading furniture dealer in the city—and the sign has served the purpose for which it was created.

The store of the Peter Kern Company, purveyors of "Good Things to Eat," is another example of the generous use of spectacular lights. Surmounting the building is a large American flag in electric lamps, and the shop is further ornamented and distinguished by two signs bearing the word "Kern's," one running vertically on the corner of the building, and one across the sidewalk.

Hope Brothers, jewelers, have succeeded in obtaining a most striking effect for the façade of their shop. Above and across the sidewalk is an elaborate sign displaying the name "Hope," and underneath, "Jewelers." This sign is fastened on the street end to the tall, dignified post-clock which further marks and advertises




the name and nature of the shop, besides being of very useful and practical service to the belated citizens of Knoxville.

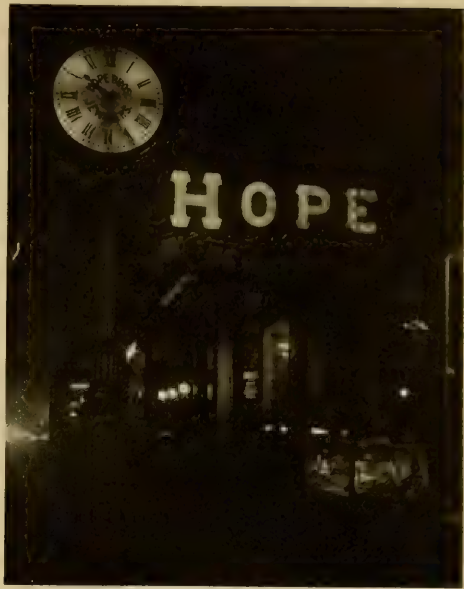
The Hotel Imperial is marked by a large sign running vertically down the building, and by another across the top of its doorway. The Colonial Hotel, with its quaint line of arches, reminiscent of foreign architecture, displays a huge horizontal sign composed of single letters spelling its name. Far down Gay Street one can see these luminous, welcoming signs; and the stranger in Knoxville has no excuse for asking, as the farmer did on entering New York by train, "Which is the way to the hotel?"

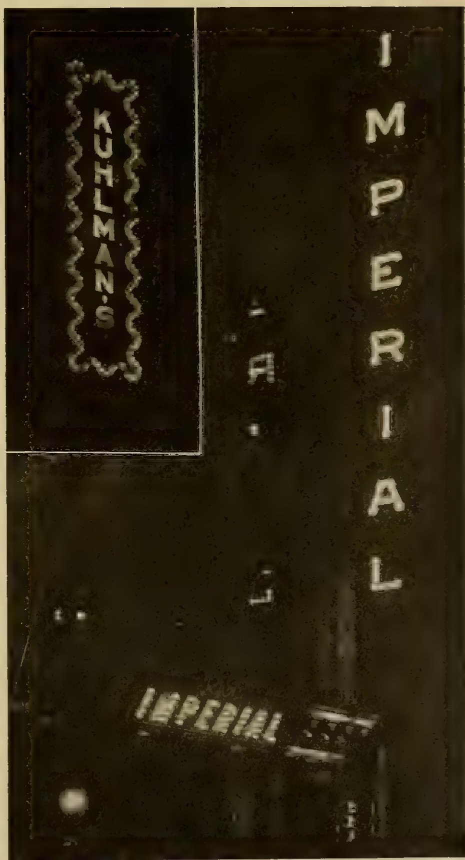
If you are hungry, perchance, you will be more than forcefully reminded of the fact as you approach Ashe's Restaurant, where you will be boldly confronted with the very suggestive word "Eat," exhibited in a large, staid electric sign of uncompromising appearance. This sign was originally one of three of a class, the other two being "Smoke," which is still displayed over Ritter's Cigar Store, and "Drink," which served as a potent motto for a nearby saloon before the town "went dry."

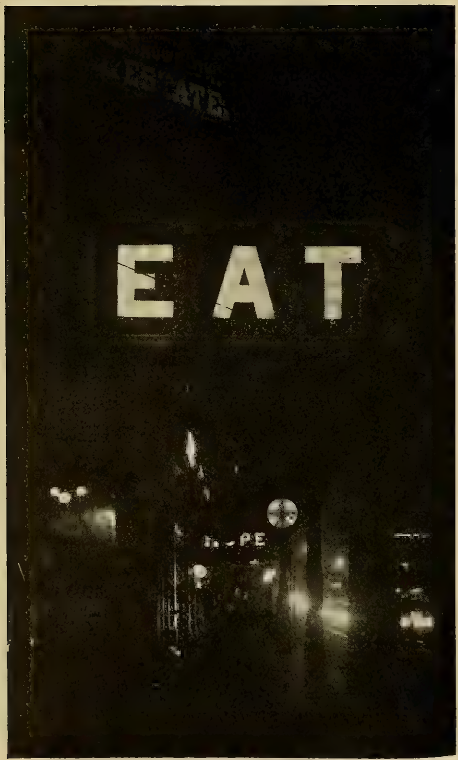
While the photographs given in this article illustrate some of the best and most striking examples of Knoxville's spectacular illumination, they only serve to furnish a fair idea of the city's general display. All along Gay Street, which by no means belies its cheery cognomen, are gay little shops and theatres, all of which, with scarcely an exception, are brilliantly illumined at night with some form of light-source, plentifully and effectively applied. All sorts of signs there are—little signs and big signs; serious signs and comic signs; theater signs, hotel signs, shop signs; automatic signs; ornamental signs; even snake signs. In front of the Miller Department Store are seven of the so-named "Doherty gas lights," while for the window display well-shaded electric lights are used with excellent effect.

The electric lighting interests in Knoxville are controlled by the Knoxville Electric Company, an illustration of whose store, with its handsome electric sign, "K. E. Co." and brilliantly lighted window, exhibiting electrical apparatus and lighting fixtures, is given in this article.

It is not to electricity alone that Knoxville owes its good illumination. Since



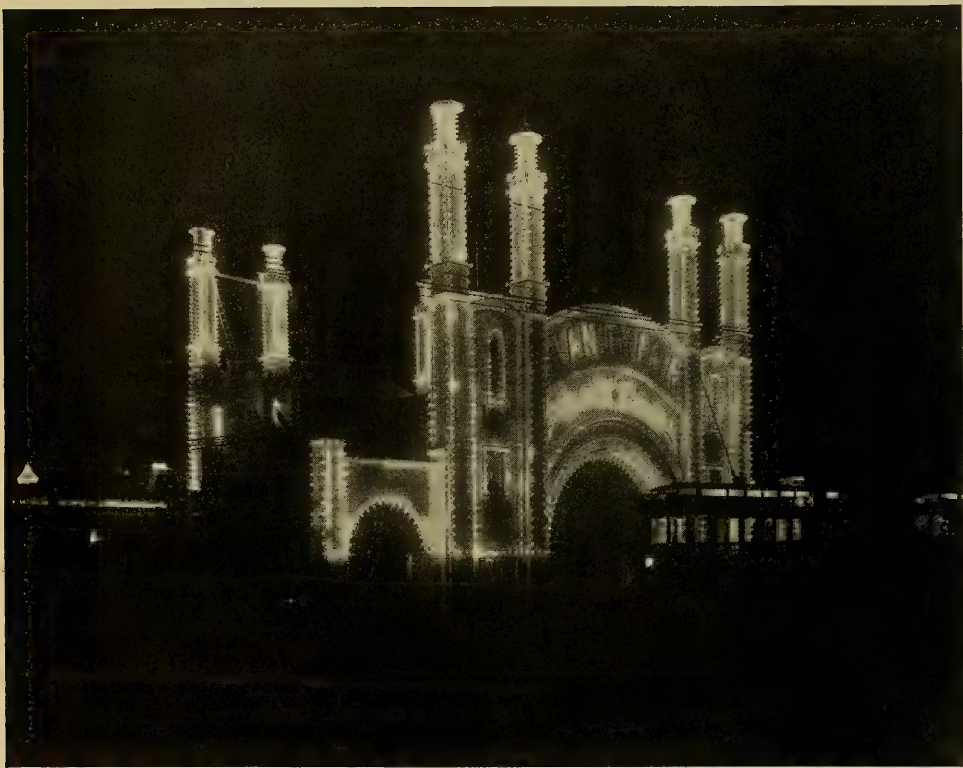



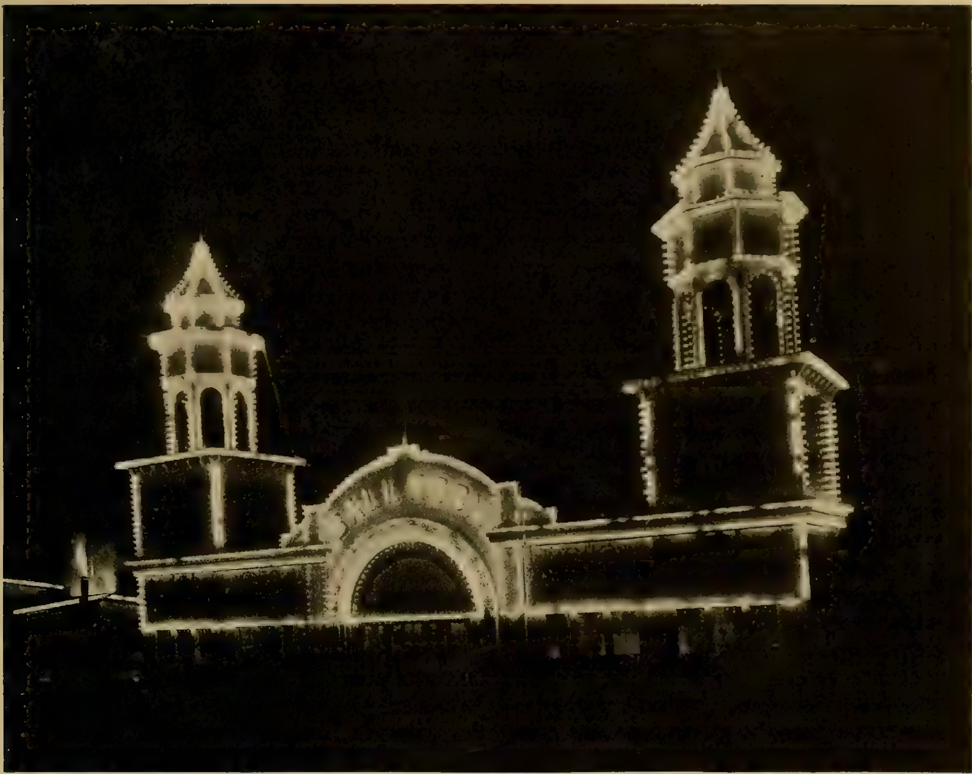

Henry L. Doherty has been in charge of the Knoxville Gas Company, the gas-lighting of the city has been of the most excellent quality. Skirting Gay Street, in front of its shops, are ornamental posts, with handsome gas lamps, which would afford Gay Street good illumination even without its generous supply of electric arcs. Since the gas lighting properties have been controlled by Mr. Doherty, much improvement has been made, not only in the plant, but in the general policy of the management of all the property. The office of the Knoxville Gas Company is now located in the downtown district, and the company has manifested in many ways a worthy spirit of progress and public benefaction. It has devoted one floor of its building to the service of church societies, in which to hold bazaars, dinners and other functions instituted for charitable purposes. They not only donate the room, but also furnish the stove and gas for cooking, and demonstrate to the public the use and convenience of the gas stove—of which, by the way, the company sold 81 carloads during the past year.

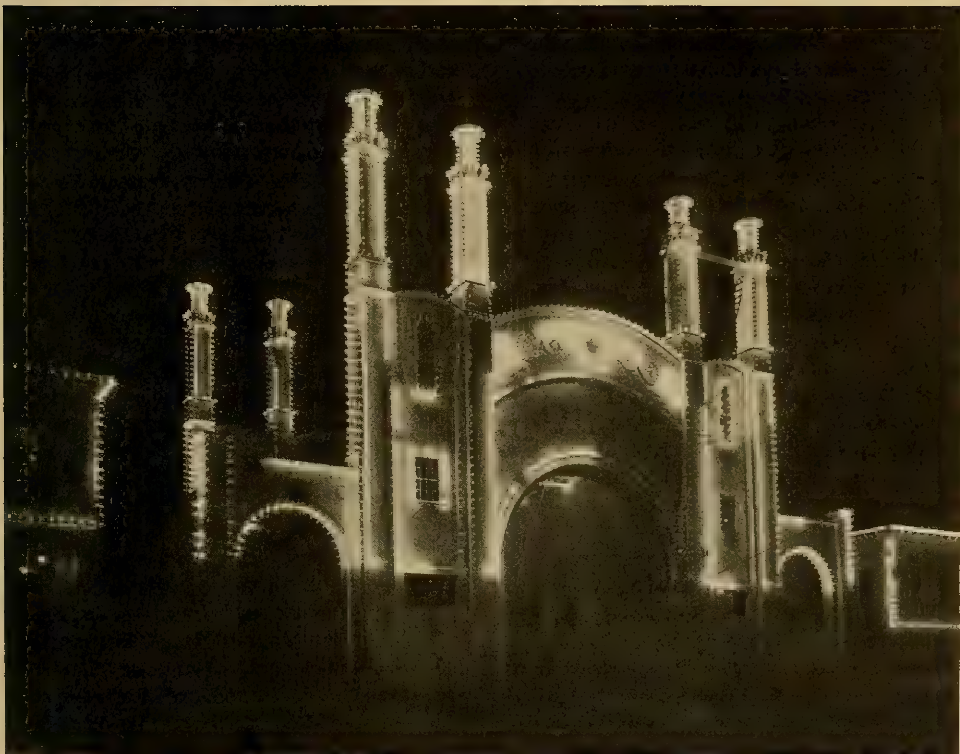

SHOW ROOM OF THE KNOXVILLE ELECTRIC COMPANY.

PRIVATE STREET ILLUMINATION BY GAS ARCS, CLEVELAND, O.

# Vanity Fair, the "Coney Island" of Providence







# Reflections on Light

By Multipolaris.

What is light?

It is often easier to ask questions than to answer them. Here is something that we are as familiar with as the air we breathe, and yet, when asked to tell just what it is, we find ourselves cornered. Let us go to the scientist; surely he can enlighten us on so simple a matter.

"What is light? Why, that is very simple—a vibratory motion of the ether."

And what is "ether"?

"Ether is the medium that fills all space."

How do you know this?

"Light travels through space, and light is a wave motion; therefore it must be a wave motion of something, and this something is called ether."

If we press him still further to describe the characteristics and properties of this "something," we find his answers growing more and more hazy, until at last, if he be thoroughly honest, we elicit the admission that he really does not know *what* the ether is; that so far as man is concerned the word is simply used as a sort of a marker to designate the outposts of human knowledge.

We can have no direct knowledge of anything which does not affect some of our "sensibilities"; and even if we add a couple of extra senses, the muscular sense and the temperature sense—to the five ordinarily accorded to us—taste, smell, feeling, hearing, and seeing, there is not one of them which directly gives us any notion of this mysterious ether. "But we see by means of light, and if light is a vibration of the ether, why does this not give us some direct knowledge of it?" you may say. Simply because it is not the ether which enables us to see, but the force which is transmitted through it.

This conception of ether, although founded upon no positive knowledge of its nature, has furnished a starting point for some of the most valuable practical discoveries that have ever been made. The idea of ether is of modern origin. Sir Isaac Newton considered light to be made up of actual particles of matter which were shot through absolutely empty space, and which entering the eye and striking the sensitive parts, produced the sensation of vision; and so great was the authority of his utterances that this theory prevailed for a long time after it had been shown to be scientifically untenable. Progress in the science of optics was seriously hampered thereby for a considerable time—a fact which demonstrates the futility of accepting any human opinion in matters of science which does not in every way accord with established facts. What is known as the wave theory of light, which is based upon the assumption of the ether, was worked out and explained in a marvelously complete and convincing manner by Dr. Young, a scientist who, for versatility of genius, thoroughness of work, and clearness of insight into natural phenomena, deserves to stand beside the greatest scientific lights of all time; and yet, outside of the professional scientists, there are very few who have ever heard his name. Dr. Young evidently did not understand the importance of having a press agent to keep his name before the public, and tamely submitted to having his discoveries ridiculed by the ignorant asses who set themselves up as critics in the literary magazines. However, false theories are as sure to die young as the good boy in the Sunday School book, or the fame of professional critics; they cannot withstand the hard knocks incident to scientific life. Had Newton been living at the time he most certainly would have hailed with joy the magnificent work of Dr. Young; but between a scientific mind like that of Newton and the mind of the literary taster, there is something of a gap.

But to return to our subject. When we define light as a vibratory motion of the ether, we have gone the limits of human knowledge at the present time. About the best we can do by way of defining the ether is to say that it is perfectly elastic, and infinitely tenuous—terms which may or may not help you to a clear understanding.

If you drop a pebble into a pond, successive circular waves will spread out

from the center of disturbance, and these waves will travel as far as there is water on which to travel. Observe, however, that it is the wave, and not the water that travels. So we are told that when a disturbance is set up in the ether, waves travel out, not over the surface as in water, but in every possible direction through the ether. But we encounter a difficulty at the outset—the rapidity with which these waves spread through the ether transcends human conception. 187,000 miles per second! In the phraseology of the day—"that is going some." But even this is easy to comprehend in comparison with the rate of vibration which produces the waves. For yellow light they tell us that these vibrations are 510 millions of millions per second; that is, when we see a yellow object, 510,000,000,000,000 waves dash against the retina of the eye every second. But these are mere figures, which are beyond the comprehension of the human mind, at least of a layman. The unscientific—and even most of the scientific, for that matter—can form no more idea of what these figures actually mean than can the editor of a technical journal of the real significance of the expression, a million dollars.

We know light as we know persons—by what it does. We know, for example, that, unlike many persons, when it starts out it goes straight ahead, at least until it encounters some obstacle. As the scientist would have it, "light travels in straight lines," so long as it has an unobstructed path. Thus, in its long journey from the sun—some 93,000,000 miles—light does not deviate from its rectilinear course until it reaches the atmosphere surrounding the earth. Then, while it passes through this with little difficulty, it still encounters enough resistance to throw it out of is regular course. In passing from air into water, light also very perceptibly changes its direction, and simliarly on going from air into glass, or vice versa. This change in direction of light rays that pass from one substance into another constitutes what the scientist calls "refraction." It was by studying this subject of refraction that Newton's theory of light was shown to be fallacious. According to his theory, light should travel faster through glass or other similar substances than through air or space; but such was proven not to be the case, hence the theory fell to the ground. The wave theory, as propounded by Dr. Young, on the other hand, agreed entirely with this established fact and while this single agreement by no means proved the theory, it substantiated it to that extent.

Refraction always takes place in rays of light when passing from one transparent substance into another, except when the dividing surface between the two substances is perpendicular to the rays; then they keep on in their rectilinear course.

The phenomena of refraction have little practical interest to the illuminating engineer. With the exception of some photometric instruments, the only application of the principle is that utilized in the construction of prismatic globes. It is the principle, however, upon which lenses of every description are made, and is also accountable for the familiar fact that an object beneath the surface of water appears bent or broken at the surface, when seen from any position not directly in front. The less familiar, but more striking phenomenon known as the mirage is the result of this refraction of light caused by its passage through strata of air of different densities. Some scientist has figured out that this condition may exist to such a perfect extent on one of the planets that, barring possible irregularities on the surface, a woman could see her back hair by looking straight ahead, without the aid of a mirror.

You cannot always tell where a man has been by observing the direction in which he enters the door; neither is it safe to assume that the thing you see is in the place where it looks to be, for the reason that you see it in the particular direction in which the rays of light from it are traveling when they enter the eye. Thus, the fortunate female on the planet referred to would see her back hair straight ahead of her, just as her terrestrial sister sees herself behind the mirror when she looks into one. "Seeing is believing"—with those who have never investigated the peculiarly illusory faculties of the eye. As a matter of fact, there is no other of the five senses which can play so many and such convincing tricks of deception. It is very unsafe to believe all that you see, especially in the newspapers.

When light, in the course of its passage through any given substance or "medium," as the scientists call it, encounters the sur-

face of a different kind of substance, somewhat complicated results follow. A portion of the light always turns back; this is called reflection. Some of it penetrates the new medium, or substance, and in certain cases more or less of its passes entirely through, in which case we say that the substance is transparent, or translucent; and some of it slackens its rate of vibration and so ceases to be light altogether, and changes to heat. The part which turns back, or is reflected, is, furthermore, never quite like the original light, and oftentimes differs very materially; then we say that the object upon which it fell is colored.

Reflection has more to do with vision, and consequently with illumination and illuminating engineering, than all the other actions of light put together. If it were not for reflection we would never see any objects except those which themselves give out light; all creation would simply be a black mass, sprinkled here and there with luminous points. Again, if all substances reflected all the light which fell upon them, the world would be a mass of spotless white. Or still again, if all bodies reflected only the most rapid vibrations, life would indeed be blue, for there would be no other color in existence. This trick that matter has, therefore, of picking out certain kinds of light for absorption, and turning back the other kinds, is a mighty fortunate thing for humanity, at least so long as it depends upon the sense of vision for the greater part of its activities.

There is still another difference in the appearance of objects due to their manner of reflecting light, and this depends not so much upon the particular kind of substance as upon the nature of its surface; if its surface is very smooth it will send the light back in definite directions, and so enable us to see the objects by the light thus reflected, as in the case of the common mirror. If it were not for the fact that surfaces cannot be made perfectly reflecting, it would be possible to have a mirror that could not be seen; and the best products of modern workmanship come remarkably near this theoretical perfection, as is evidenced by the fact that mirrors are frequently protected by rails to avoid collision between their surfaces and the unsuspecting observer. For a similar reason, a perfectly transparent substance would not be visible. The persistent attempts of flies, and even of birds, to pass through the glass in a window is an illustration of this fact. Imperfection serves a useful purpose in this world, after all; and if we could actually find a perfect man, it is doubtful if we would comprehend him any better than we would the perfect mirror or perfectly transparent body. People and things differ mostly in their imperfections, and these imperfections are decidedly their most interesting features.

Light has always been used as the symbol of knowledge, and the force of the symbolism is apparent enough; but why should reflection be used to denote deep and careful thought? It is by the reflection of light that we see and know visible objects; and it is by directing thought, which is the radiation of the brain, against the mind itself, and observing what comes back and what is lost, that we get what little understanding we have of that phenomenon which is more unscrutable than the ether itself—*man*. The word "man" is here used in the sense defined by a French savant—viz., "Man: a generic term, embracing woman."

Still one further observation on the reflection of light: If the surface which it strikes is rough, or uneven, then the rays, instead of turning away in definite directions, scatter in every possible direction from every point; consequently some rays from each point will come to the eye, provided no obstruction intervenes, and so we see every point of the object. It happens that the great majority of natural objects have rough surfaces, which enables us to see them distinctly from every direction.

But some objects have very smooth surfaces and are still distinctly visible, as, for example, a piece of highly polished wood; but in this case there are really two surfaces, that of the varnish on the outside and of the wood in contact with the varnish, so that we may see an image due to reflection from the outer surface of the varnish, and at the same time see with comparative distinctness the natural surface of the wood beneath. As in the case of the smooth or polished surface, we do not find perfection in the case of rough surfaces—that is, there is never a surface so rough that it does not reflect some light in a regular manner like a smooth or polished surface. Neither is there any surface that absorbs all light falling upon it. The devil is not as black as he is painted,

because there is no black paint but what reflects more or less light; even black velvet has a distinct reflecting power. The only wholly black object is a hole into a dark space, and this is not a surface at all.

There is probably no object that is absolutely white. "Though your sins be as scarlet, they shall be whiter than snow," is very likely not a metaphorical exaggeration. To be "whiter than snow" means simply that an object is a more perfect reflector of light, not only in the amount of light reflected, but in the completeness with which it reflects all the different kinds, or colors, of rays. It is a curious but familiar fact that black is one of the hardest shades to match, and that there are many variations of what commonly passes for whtie. Even substances which are commonly thought of as transparent vary materially in their color. One of the greatest difficulties that manufacturers of glass encounter is in maintaining a uniform color in the glass.

Light is a mystery, but a mystery which science has unraveled to the point where the thread is lost in the universal web beyond which the human mind cannot penetrate. But what happens when we "see?" Light enters the eye and an image of the object is formed by the lens upon a surface at the rear. So far it is very simple; the eye in principle is only a photographic camera. But here the simplicity and positive knowledge end. From the image on the retina to the mental impression which we call seeing, there is an impassable gulf in human knowledge. The most diligent study and the most exact methods of trained scientists have been unable to fathom the mystery. They say that "light produces a photo-chemical change in the retina;" if this collection of words makes the matter any clearer to you, you are welcome to the knowledge. To the average layman many of the explanations of the scientist suggest the habit of the cuttle fish, which, when dangerously pursued, escapes in the obscurity of its own inky exudations. Who was it that said that "words were made to conceal thought?" They are equally useful for concealing ignorance.

The mere physical action of light can be readily followed by the scientist, and even to a certain extent by the layman, but at the point where it is converted into a mental impression it passes beyond human ken. What happens when we see no one knows, nor is likely to know until the human mind enlarges its present powers of conception. If we could know this we could know all. As Tennyson expresses it:

"Flower in the crannied wall,
  I pluck you out of the crannies,
If I could know you all in all,
  I would know what God and Man is."

# Theory and Technology

## The Calculation of Illumination with the Ordinary Slide Rule

By J. S. Codman.

The appearance of the Macbeth calculator described in the March edition of The Illuminating Engineer indicates the final stage in the evolution of devices for the rapid calculation of illumination from the law of inverse squares. The slide rule method of calculation certainly appears to have great advantages over methods employing tables, curves or diagrams, and with the advent of a practical device, this method seems bound to supersede the others.

It is interesting to note in this connection that the ordinary slide rule lends itself readily to the solution of illuminating engineering problems, and although it is of course very inferior to a specially designed slide rule such as the Macbeth, nevertheless, the fact that it can be used for all sorts of miscellaneous problems and is consequently regularly carried in the pocket by many engineers, makes it often more convenient to use than any special diagram or scale.

If we consider the formulæ:

$$I_n = \frac{\text{candle-power} \times \cos^2 \phi}{h^2}$$

for normal illumination, and

$$I_H = \frac{\text{candle-power} \times \cos^3 \phi}{h^2}$$

for horizontal illumination, it is evident that after the values of $\cos^2\phi$ and $\cos^3\phi$ are determined, the calculation of illumination can be done on the slide rule by the ordinary processes of multiplication and division. Further than this, however, it is quite simple to ascertain the values of $\phi$, $\cos^2\phi$ and $\cos^3\phi$ from the slide rule, if the height, h, and the distance from the foot of the perpendicular, l, are given, as is usually the case. If we divide l by h, the result is $\tan\phi$, and from this we can obtain $\phi$ with a slide rule by the use of the "T," or tangent scale on the back of the slide. Then, $\phi$ being determined, we can find $\cos\phi$ by the use of the "S," or sine scale, since $\cos\phi = \text{sen}(90° - \phi)$. The $\cos^2\phi$ and $\cos^3\phi$ can then be found with the scale by the ordinary rules of squaring and cubing numbers.

The above method of finding $\phi$, $\cos^2\phi$ and $\cos^3\phi$ may seem at first sight rather a long process, but it can be done very quickly if the slide is manipulated in the manner described below.

To take a concrete example, first, let us suppose that $h = 9.5$ and $l = 7$. Place the right hand index of the "T" scale over 9.5, and find over 7 the angle $\phi$, equal to 36° 22′. Then $(90° - \phi)$ equals 53° 38′. Set slide so that indices of slide and stock correspond, and read over 53° 38′ on "S," or sine scale, the $\cos\phi$ equal to 0.805. Transfer value of $\cos\phi$ to lower scale, and set runner over it. The $\cos^2\phi$ will then be under the runner on the upper scale and the $\cos^3\phi$ can be found by turning over the slide and multiplying $\cos^2\phi$ by $\cos\phi$, the values of which, as before stated, being under the runner on the upper and lower scales, respectively.

In the above case h was greater than l. If now we assume that $h = 7$ and $l = 9.5$,

we begin, as before, by placing right hand index of "T" scale on the higher of the two values, that is, on 9.5; but in this case we shall find over 7, not the value of $\phi$, but the value of the complement of $\phi$, viz., $(90^\circ - \phi)$, from which $\phi$ can be found. Using the value obtained of $90^\circ - \phi$, the $\cos\phi$ can be found by means of sine scale, as in first example, and the remainder of process also is the same.

In both the above examples the first step in the process was to set the right hand index of "T" scale on the higher of the two values, and this is the rule whenever the first digit in the greater number is greater than the first digit in the smaller number. When the reverse is the case, the left hand index of "T" scale should be set over the greater number instead of the right hand index. For example, if h = 1.2 and I = 8. Place left hand index of "T" scale over 12, and read over 8, the angle $\phi$, $33^\circ\ 42'$. The remainder of process is the same as in the other examples.

From the above it will be seen that the general rule is as follows:

Given the values of h and I, place the index of "T" scale over the greater of the two values, using right hand index of "T" scale when first digit of the greater value is greater than first digit of the smaller value, or using left hand index of "T" scale when first digit of the greater value is less than first digit of the smaller value. Then over the smaller value will be found either $\phi$ or $(90^\circ - \phi)$. It will be $\phi$, if h is greater than I, but $(90^\circ - \phi)$ if I is greater than h. Next set the slide so that indices correspond with indices of stock and read over $(90^\circ - \phi)$ on the "S" scale, the value of $\cos\phi$. Transfer $\cos\phi$ to lower scale and set runner on it and $\cos^2\phi$ will be found under runner on upper scale. If $\cos^3\phi$ is wanted we have but to turn the slide and multiply by the ordinary processes, the $\cos^2\phi$ and $\cos\phi$, the values for which appear under the runner on the upper and lower scales, respectively.

# The Illumination of Shady Streets

By A. R. Dennington.

That the system of lighting streets lined with shade trees by means of arc lamps placed at the corners is unsatisfactory as far as the effectiveness of the illumination is concerned, has been apparent to all who have had occasion to attempt walking or driving by the aid of the artificial light, but perhaps but few have taken the trouble to analyze the difficulty.

The arc lamps usually employed for street lighting at the present time are of the enclosed type, giving a maximum intensity of about 200 candle power at an angle of approximately forty degrees below the horizontal. The principal disadvantages of the street corner arc system may be stated as follows:

1. High intrinsic brilliancy of source, which is within the field of vision.

2. Dense shadows cast by trees or other obstructions.

3. Inefficient angle at which the rays strike the street.

4. Distribution of light not uniform.

High intrinsic brilliancy is not a defect if the source can be kept out of the ordinary range of vision, but this is absolutely impossible in the case of street lamps. The line of brilliant points which indicates the direction of the street cause the pupil of the eye to contract, and in this way serve to intensify the blackness which seems to envelop the immediate surroundings.

The object which should be sought in planning any lighting system is to secure light on the object which is to receive the attention, instead of diverting the attention to the source of illumination. That illumination is nearest perfect which makes the light sources most inconspicuous, and brings into prominence the object or surface it is desired to light. The street corner arc system grossly violates this principle, and the trouble has, in some instances, been intensified by the installation of flaming arc lamps with clear globes.

Another defect of the system is the effect of shadows. The sources are comparatively few in number, and consequently the effect midway between the lamps is greatly modified by the shadows cast by intervening objects. The shadow of each

leaf and twig and even the shadow of the traveler himself is projected forward so as to cut off the direct rays from the space immediately ahead. The lights are thus so placed that the one in front interferes with vision by causing a contracton of the iris while the rays from the one in the rear are cut off from the space where illumination is most desired. These conditions are worst in times of storm when the air is filled with rain or fog.

The rays of light from the corner arc are almost horizontal near the center of the square, and so there is very little light reflected in useful directions. The small inequalities of the street surface prevent many of the rays from being directly reflected and as the intensity is greatly reduced by each reflection, the total useful reflected light is extremely small. The light coming at such a small angle to the horizontal tends to magnify inequalities of surface, which is another disadvantage.

Uniform distribution of light cannot be obtained from sources of high brilliancy spaced at infrequent intervals unless unusual conditions exist regarding height and reflecting surfaces. There will be a spot in the immediate vicinity of the lamp which will be brightly illuminated. On this area few or none of the disadvantages enumerated exist, because the lamp is fairly well removed from the range of vision, and the light comes from above so the reflection is at a good angle. There is more light than is needed near the lamp and less than the amount desirable at points remote. These brilliant places have a disadvantage that is not so noticeable with systems having a more uniform distribution in attracting swarms of insects which in many cases are an annoyance to pedestrians.

The only method of giving a fairly uniform distribution on streets, especially those lined with trees, is by using a large number of lamps of comparatively small candle power. The results which may be attained with this system, whether gas or electricity is used as the illuminant, are far more satisfactory than is possible with the arc system. The lamps should be arranged with alternate lamps on opposite sides of the streets. As it is not practical or desirable to place the lamps at greater heights than ten or twelve feet, they should be provided with diffusing shades or globes which completely hide the filament or mantle and which also give a wide distribution of light. From the standpoint of efficiency and appearance, the prismatic shade is far in advance of all others, but of course it has the disadvantage of being somewhat expensive and is not unbreakable. The objections to metal shades are that they either concentrate the light too much or do not come down far enough over the filament or mantle to prevent direct rays from shining into the eyes.

Iron posts should be used for the lamps, if the expense does not prohibit, as they are neater and more durable than wooden ones. In suburban districts the design of the posts is of much less importance than in business districts because posts located among trees are not conspicuous. For this reason, neat wooden posts painted some dark color to harmonize with the general surroundings may be used. The lamps should preferably be placed at the top of the posts, and if gas is used, the inverted mantle is best suited to the conditions; while if incandescent lamps are employed, the tip should be downward. When it is necessary to place the lamps on side brackets, as might be the case when incandescent lamps are used and are placed on the side of the pole supporting the transmission line, the brackets should preferably project on the side of the pole next the walk. If two lamps are used, one should be on the street side and one on the walk side of the pole, as in this way the shadow of the pole is not thrown lengthwise of the street. With a distance between consecutive lights on the same side of the street of 200 feet and lamps of about 50 candle power, a fairly uniform illumination would be obtained. With this spacing from eight to twelve incandescent lamps would be required to replace one arc. An illumination more satisfactory than the arcs may be obtained with the minimum number. A calculation of the minimum illumination for arc lamps located 400 feet apart gives a minimum horizontal intensity of about 0.00124 candle feet. In comparison with this, 50 candle power incandescents spaced 200 feet apart on one side of the street, and having the lamps on the opposite side located midway between, will give a minimum horizontal intensity of about 0.003 candle feet, or more than double that of the arcs.

The energy required for the incandes-

cent system, allowing twelve incandescents for one arc, would be greater than for the arc system. The difference would be about 125 watts per arc in favor of the older system. The cost of trimming the arcs would more than offset the care required by the increased number of the incandescent units. Renewal of the incandescents would be required only once or twice each year, depending upon the life and type of lamp used. The wiring cost of the incandescent system would be about double that of the arc system, but it would seem that any increased expense would be justified by the increased efficiency and effectiveness of the illumination secured.

# Recent Progress in the Voltaic Arc

By Isidor Ladoff.

(*Continued*)

We may never attain the efficiency of light emission accomplished by the glowworm or luminous insects, producing only ether vibrations included between 0.81 and 0.360 m.

But the time seems to be ripe for an attempt to utilize the luminescence of metals and oxides of metals.

The first noteworthy improvement in the carbon arc was produced by the pioneer in this field in the United States, Mr. Charles F. Brush of Cleveland. He took out a patent in 1877, No. 196,425, in which he claimed a metallic shell for electric arc electrodes. The two claims attached to this patent are as follows:

1. As an article of manufacture, carbon (or other materials suitable for use as illuminating points in a device for producing electric light) permanently covered, coated, or surrounded with copper, nickel, or other suitable protecting and electro conducting substance.

2. A carbon stick, point, disk, or plate electroplated with copper, nickel, or any suitable metal.

It is curious that this same device was patented over and over again, as we will see later, by other inventors.

In 1880, December 7, a patent, No. 235,-203, was issued to Mr. Julius E. Braunsdorf for a carbon pencil provided with a central metallic tube filled with non-conducting material for increasing or coloring the light.

A patent issued Dec. 6, 1881, to Mr. Samuel W. Skinner and Mr. William M. Thomas claims as a new process of manufacturing an iridium-tipped metallic rod, which consists in charging with granulated iridium a cup-formed carbon positive electrode and bringing the same, while under the action of galvanic discharge, into repeated contact with the tip of a rod of other metal.

Mr. Patrick N. Mackay received letters patent No. 325,257, dated Sept. 1, 1885. He claims in this patent material for the manufacture of electrodes for electric lights, consisting of a mixture of the *oxide of titanium* in powder and a hydrocarbon oil. This invention is of sufficient importance to warrant a short extract of the specification. Mr. Mackay employs as a principal element or substance the mineral oxide of titanium or as it is obtained in either of the forms of "anatase," or "octahedrite," "rutile," and "brookite," or as it is found in titaniferous minerals and other combinations of titanic acids. He reduces the substance to an impalpable powder by any suitable means and proceeds to form a pasty mass of proper consistency to take and retain the shape and forms required upon application of pressure after the manner generally followed in manufacturing electrodes. He produces the paste or material from which to make electrodes according to his invention by combining a hydrocarbon oil and the powdered oxide of titanium together, and uses for this purpose any suitable hydrocarbon, animal, vegetable, or mineral oil having suitable consistency to form, with the powdered mineral, a paste or pasty mass. The proportions that he has found suitable are from 15 to 20 parts of the hydrocarbon to 100 parts by weight of the powdered oxide of titanium.

In manufacturing incandescents from this material, he proceeded to mold the paste into strips or ribbons or other forms and subject them to great pressure by means of a hydrostatic press. In the course of this operation, he produces a skin or protecting shell upon the surface of the finished incandescent by covering the faces of the molds and the surface of the strips of pieces of paste with the powdered oxide of titanium in a dry state. This has the effect of absorbing any excess of moisture in the strip and thus give greater solidity, as well as to produce an external skin on the finished incandescent.

In his specification, Mr. Mackay says, among others, "I am aware that among other highly-refractory metals suited to the purpose *titanium* in the form of beads, rods and strips has been suggested for the light-giving part or body in incandescing lamps, and I therefore *make no claim,* broadly, *to* such a point or *conductor from the metal titanium or from the oxide of that metal by itself."* This patent obviously relates not to arc light pencils, but to incandescent lamps.

In connection with this, the British patent issued to Thomas Alva Edison in 1878, 23rd of October, No. 4226, has to be mentioned. In this patent, the inventor claims, among other things, a rod of carbon *titanium oxide* or any other conducting body for the purpose of producing incandescent light. The electric light is derived by the passage of the current through a spiral core of wire or through a strip of metal, or through carbon or any other material that will become incandescent. He also recommends a globule or small bar of silicon, boron, *titanium* or other substance between carbon, platinum or other metal rods.

Another United States patent was issued to Thomas A. Edison in February, 1893, No. 492,150. This patent contains the following claims:

The process of coating a flexible carbon filament designed for the incandescing conductor of an electric lamp, with insulating material, consisting in heating said filament while in a mass of such material, thereby fusing a layer of such material to said filament. The insulating material refers to boron, silicon or like elements.

A rather curious Canadian patent was issued Oct. 6, 1884, to John Augustus Moffitt and James Gilbert Foster. The inventors claim to be able to increase the durability of the Carbon Pencil or Film or Conductor under the action of the electrical current, by mixing with the carbon of which the film, conductor or pencil may be made, whether such carbon be lampblack, ivory black, gas retort or other suitable kind of carbon, in a highly reduced state, or in form of an impalpable powder, a quantity of the substance known by the name of "infusorial earth" or "diatomacae" in a pulverized or powdered, ground or properly reduced state.

Letters Patent No. 484,553, dated Oct. 18, 1892, were issued to Lewis L. Jones for the electrode and incandescent electrical conductor. The claims of these patents are as follows:

1. In the manufacture of electrodes and incandescent electrical conductors, the process consisting in *mixing* solutions containing a *non-conducting earth and a metal,* then drying the mixture, *converting into oxides,* and forming into an electrode or conductor.

2. In the manufacture of electrodes and incandescent electrical conductors, the improvement consisting in forming a paste composed of a *refractory or non-conducting oxide, a metallic* or *conducting oxide,* and a fluid binder consisting of an acid solution of one or more oxides and forming the article therefrom.

3. In the manufacture of electrodes and incandescent electrical conductors, the improvement consisting in forming a paste composed of a refractory or non-conducting oxide, a metallic or conducting oxide, and a fluid binder consisting of the acid solution of two oxides, one refractory or non-conducting, the other metallic and conducting, and forming the article therefrom.

4. The described process of manufacturing *electrodes* and incandescent electrical conductors, consisting in first forming the article *from* a paste composed of *a refractory and a metallic oxide* and an acid solution of one or more oxides, then drying the article and subjecting it to a high heat.

5. The described process of manufacturing electrodes and incandescent electrical conductors, consisting in first forming the article from a paste composed of a refractory and a metallic oxide and an

acid solution of one or more oxides, then drying the article, dipping it in a metallic solution and finally subjecting it to a high heat.

6. The described process of manufacturing electrodes and incandescent electrical conductors, consisting in first forming the article from a paste composed of a refractory and a metallic oxide and an acid solution of one or more oxides, then drying the article, dipping it in a metallic solution, and finally subjecting it to a high heat in surface contact with a reducing substance, such as carbon.

7. The described electrode or incandescent electrical conductor, composed of a *homogeneous mixture of refractory or non-conducting oxide and metallic or conducting oxide,* forming an integral structure, having near the surface an increased deposit of conducting oxide.

8. The described electrode or incandescent electrical conductor, composed of re-refractory or non-conducting oxide and metallic or conducting oxide, forming an integral structure, having its pores filled with conducting oxide and its surface coated with a metal.

A German patent was issued July 17, 1888, No. 44,183, to the firm of Haefener & Langhans, in Berlin, for the manufacture of a mineral filament giving light in electric incandescent lamps into which the current is turned into light by the resistance of the conductor. The patent claim is as follows:

Light producing elements (leucht element Faden) or filaments for electric incandescent lamps, consisting of an inner vein of metallic acid salts, having as its base forming component parts the oxides of calcium, magnesium, borium, strontium, aluminum, beryllium, cerium, lantanium, didymium, erbium, Terbium, yttium and gallium, as acid forming substances the oxides of zircanium, uranium, *titanium,* molybdenum, thorium, single or in mixtures—surrounded by a firmly adhering specially conductive crust of carbon, silicon or boron.

The same party received British patent No. 2438 in 1888, which contains the following single claim:

A filament for electric incandescent lamps consisting in a vein or core composed of one or more of the oxides of calcium, magnesium, borium, strontium, aluminum, beryllium, cerium, lantanum, didymium, erbium, terbium, yttrium and galium and one or more of the oxides of *titanium,* uranium, circonium, molybdenum and thorium. The said vein or core being coated with carbon, silicon or boron.

Letters patent No. 421,469, dated Feb. 18, 1890, were issued to Walter Ernest Adeney. The subject matter of his invention is specially designated as follows:

The method of manufacturing electric-arc carbons is as follows:

Powdered gas coke is mixed with powdered coal in the proportion of coke varying from eighty to fifty per cent. To this mixture is added one to ten per cent of *infusible* or *difficultly fusible* substance. such as compounds of aluminum, silica, calcium, iron, etc., glass, cyanite, kaolin, beauxite, asbestos, pumice, feldspar, gadolinite, samarskite, quartz, zircon, limestone, strontianite, dolomite, witherite, phosphate of lime, braunite, *titanic iron,* chrome iron ore, wolfram, molybdenite, fluorspar, cerite, cryolite, phosphate of aluminium, megnesite, or compounds of nickel and cobalt. These refractory substances are used to render the impurities in the coal and coke as difficultly fusible as possible, and hence, increase the *intensity* and *steadiness* of the electric arc light and the *durability* of the carbon. After cerefully mixing the ingredients are introduced into an iron mold and heated under pressure, first gently, but finally very strongly. The carbon rod thus made, if too porous, is heated into hot coal tar, and the whole heated for some time, preferably in a vacuum. The carbon rod is then taken from the coal-tar, its surface cleaned, and again introduced into a mold and heated under pressure. He claims:

1. The method of manufacturing electric-arc carbons, which consists in mixing together powdered gas-coke, powdered coal, and an infusible or difficultly fusible material, inserting the mixture in a mold, heating it under mechanical pressure, revolving the carbon pencil thus formed. immersing it in hot coal-tar and heating it, then taking it from the coal-tar and cleaning its surface, and again introducing it into a mold and heating it under mechanical pressure.

2. To form a carbon pencil, removing the pencil, immersing it in hot coal-tar,

and then reheating the pencil under mechanical pressure in a mold.

3. The hereinbefore described improvement in the manufacture of electric-arc carbons, which consist in mixing powdered gas-coke, powdered coal, and an infusible or difficultly fusible material, forming this mixture in a mold under heat and mechanical pressure and immersing it in hot coal-tar and reheating under mechanical pressure in a mold.

4. A carbon for electric lights consisting of a mixture of powdered gas-coke, powdered coal, and an infusible of difficultly fusible material in about the proportions specified impregnated with coal-tar and united under heat and pressure.

Letters Patent No. 422,302, dated February 25, 1890, was issued to Henry Haswell Head. This patent is very similar to the previous one, and contains also among other substances, *titanic iron.* What is meant by the expression in both of these patents is not very clear. It could not mean the alloy of iron and titanium, because at the time the patent was issued, this alloy was unknown. It could not mean titaniferous iron ore, because the ore does not contain either metallic iron nor metallic titanium. At any rate, it seems to be clear that the lighting improvement or light producing properties of titanium were unknown to the inventors, otherwise they would have claimed it.

Letters Patent No. 460,595, dated Oct. 6, 1891, were granted to Isaiah L. Roberts. The invention chiefly consists of a *metallic shell* filled with chromate of iron and *hydrate of soda.* The claims are as follows:

1. A pencil for arc-lamps, composed of a metal associated with a substance containing chromium.

2. A pencil for arc-lamps, consisting of a metal tube or holder filled with a substance containing chromium.

3. A pencil for arc-lamps, consisting of a *metal tube* or holder filled with chromate of iron and an illuminant, such as *hydrate of sodium.*

The same Isaiah L. Roberts received Letters Patent No. 460,597, dated Oct. 6, 1891, claiming combination of a carbon electrode containing chromium. In his Letters Patent No. 460,596, dated Oct. 6, 1891, the same Isaiah L. Roberts claims:

1. A pencil for arc-lamps, composed essentially of carbon and a substance containing chromium, in combination with a metallic conductor or holder, with which it is associated.

2. A pencil for arc-lamps, composed of a refractory compound containing chromium, in combination with a tube or cylinder of perforated metal, such as wire-gauze.

3. A pencil for arc-lamps, composed of a mixture of carbon, a substance containing chromium and caustic potash, in combination with a holder of wire-gauze.

Letters Patent No. 504,845, dated Sept. 12, 1893, issued to Robert McManus, contains the following claims:

1. The combination of coke, mineral oil and *iron* to form pencils or electrodes.

2. A carbon pencil or electrode consisting of a composition of coke and mineral oil *coated with iron.*

3. A carbon pencil or electrode consisting of a composition of coke, mineral oil and *iron coated with iron.*

Letters Patent No. 496,701, dated May 2, 1893, issued to John Frederick Sanders. This invention relates to a carbon pencil consisting of pulverized coke or other suitable carbon, nine hundred and eighty parts. Second, *salts of calcium or magnesium,* twelve parts. Third, a *reducing agent,* such as cyanide of potassium, *bicarbonate of soda* or *phosphoric acid,* five parts. Fourth, a coloring metal, such as a *salt of strontium,* or a salt of *lithium,* or a salt of *indium,* three parts. Fifth, a suitable bond, such as gas tar, sugar mucilage. These ingredients are thoroughly pulverized and well mixed. The mass is then placed in a mold of the required size and form, and these molded forms are then burned until all oils and volatile matters have been expelled and a partial or complete reduction of some of the admixed ingredients has been accomplished. The reducing agent may be either cyanide of potassium, phosphoric acid or bicarbonate of soda, or these ingredients may be used together, the function being to *reduce the salt of calcium or of magnesium to metals,* and also to add color to the light. The claims of this patent are as follows:

1. An electric light carbon composed of a homogeneous mass of carbon, *a light giving metallic salt,* a reducing agent and a binder.

2. An electric light carbon composed of pulverized coke or other suitable carbon, the phosphates of calcium and magnesium, cyanide of potassium, bicarbonate of soda and phosphoric acid, salts of strontium, lithium and indium, and a suitable bond to hold the mass together.

3. An electric light carbon composed of pulverized coke or other suitable carbon, the phosphates of calcium and magnesium, cyanide of potassium, bicarbonate of soda, salts of strontium, lithium and indium, oxide of zinc, and a suitable bond to hold the mass together.

4. An electric light carbon having a *coating of copper* and a second coating of an *illuminating metal,* as *magnesium,* calcium, *antimony or zinc.*

5. An electric light carbon composed of pulverized coke or other suitable carbon, a salt of calcium or magnesium, a reducing agent as cyanide of potassium, bicarbonate of soda or phosphoric acid and a coloring metal, as a salt of strontium, lithium or indium, said carbon having a coating of copper, and a second coating of an illuminating metal as magnesium, calcium, antimony or zinc.

6. An electric light carbon composed of pulverized coke or other suitable carbon, a salt or calcium or magnesium, a reducing agent as cyanide of potassium, bicarbonate of soda or phosphoric acid and a coloring metal as a salt of strontium, lithium or indium, said carbon having a coating of copper, a second coating of an illuminating metal as magnesium, calcium, antimony or zinc, and a third coating of silver or copper.

Edward Goodrich Acheson received Letters Patent No. 527,826, dated Oct. 23, 1894, in which he claims an illuminating body for electric lamps comprising carbon associated with carbide of silicon.

Jones Walter Aylsworth received letters Patent No. 553,296, dated Jan. 21, 1896, for an incandescent electric conductor composed of *refractory metals,* as *tantalum, niobium, titanium, molybdenum, zirconium* and other metals of the same general class which are known to be nonfusible for such temperatures as are capable of practical application in the arts and also are non-ductile.

Sept. 22nd, 1896, Letters Patent No. 568,231 were granted to Henry Blackman for an electrolytic anode composed of *magnetic iron oxide and iron titanium oxide or ilmenite.* Although this electrode is used for only electrolytic purposes and is recommended as an anode while in the arc light, such an electrode would have to be necessarily cathodic, this patent is very interesting by its suggestivity of the combination of the oxides, of which one is light-giving and a poor conductor, and the other a camparatively good conductor of electricity but non-luminous.

Carl Kellner was granted Letters Patent No. 666,610, dated Nov. 13, 1900. The invention relates to incandescent bodies consisting of infusible metals which are not very good conductors of electricity and which have a high capacity of emitting light, such as thorium, or of almost infusible metals, such as *titanium* (in the form of *pure titanium* or *nitrid of titanium*), chromium or wolfram, or *alloys of such metals,* incandescent bodies made of these infusible or almost infusible metals or alloys being *oxydized at their surfaces,* or of mixtures of almost infusible metals or alloys of the same, of graphite of the kind which offers the very greatest resistance to conversion into graphite acid by potassium chlorate and nitric acid (graphite of high density up to 2.25 specific gravity) with metallic oxides that are infusible or are fusible with difficulty and capable of emitting light, such as thorium oxid, with or without an addition of cerium oxid. Incandescent bodies of the kind referred to are powdered, pressed and treated in the usual manner in order to make the incandescent bodies out of them. When the bodies are made of thorium *metal or metals* fusible with difficulty, such as titanium, chromium, or wolfram, or alloys of such metals alone, they are *oxidized at their surfaces* by being made to glow in the air by immersion in an oxidizing liquid or by being inserted as an anode in an electric circuit, which decomposes an electrolyte of which oxygen is the anion or by any other suitable means. The thin layer of oxide adheres so firmly to the metal that it is not damaged when the incandescent metal is used.

(*To be continued.*)

# Table of Efficiences of the Most Common Sources of Light*

By Dr. H. Lux.

| Source of Light. | Consumption of Energy. | Total Spherical Radiation. | Spherical Light Radiation (between 0·4 and 0·8 $\mu$ wave length). | Ratio of Light Radiation to Total Radiation. | Ratio of Light Radiation to Consumption of Energy. | Mean Horizontal c.p. | Mean Spherical c.p. | Watts consumed per mean Spherical Hefner Candle. | Energy equivalent of one mean Spherical Hefner Candle. |
|---|---|---|---|---|---|---|---|---|---|
| | Watt. | Watt. | Watt. | Per Cent. | Per Cent. | H.K. | H.K. | Watt. / H.K. | Watt. / H.K. |
| Hefner lamp ... ... ... | 86·3 | 9·96 | 0·089 | 0·89 | 0·103 | 1 | 0·825 | 104·6 | 0·108 |
| 14-inch Petroleum lamp* ... | 508·0 | 102·2 | 1·26 | 1·23 | 0·25 | 14·2 | 12·0 | 42·3 | 0·105 |
| Acetylene flame† ... . . ... | 96·0 | 9·78 | 0·62 | 6·36 | 0·65 | 7·7 | 6·04 | 15·9 | 0·103 |
| Incandescent gas light :— | | | | | | | | | |
| (*a*) Vertical, without chimney ... | 716·7 | 147 | 3·28 | 2·26 | 0·46 | 107 | 89 6 | 7·98 | 0·037 |
| with chimney ... | | 112·1 | | 2·92 | | | | | |
| (*b*) Inverted, without globe . . | 571·0 | 143 | 2·9 | 2·03 | 0·51 | 107 | 82·3 | 6·97 | 0·035 |
| with globe ... ... | | 97·6 | | 2·97 | | | | | |
| Electric carbon filament glow lamp with globe ... ... | 98·23 | 63·5 | 2·03 | 3·2 | 2·07 | 31·5 | 24·5 | 4·09 | 0·085 |
| Ditto without globe ... ... | | 75·2 | | 2·7 | | | | | |
| Nernst lamp without reducing-rheostat ... ... ... ... | 165·0 | 122·2 | 6·96 | 5·7 | 4·21 | 120 1 | 94·9 | 1·74 | 0·073 |
| Ditto with reducing-rheostat | 181·4 | | | | 3·85 | | | 1·91 | |
| Tantalum lamp‡ ... ... .. | 44·0 | 25·2 | 2 15 | 8·5 | 4·87 | 34·6 | 26·7 | 1·65 | 0·080 |
| Osram lamp‡ ... ... ... | 38 3 | 22·5 | 2·05 | 9·1 | 5·36 | 36·3 | 27·4 | 1·43 | 0·075 |
| Direct current arc lamp ... ... | 435·0 | 301·8 | 24·3 | 8·1 | 5·60 | 190 | 524 | 0·83 | 0·047 |
| Ditto enclosed arc ... ... | 541·0 | 308 | 6·2 | 2·0 | 1·16 | 200 | 295 | 1·31 | 0·021 |
| Flame arc lamp, yellow light ... | 349·7 | 295 | 46·2 | 15·7 | 13·20 | 907 | 1145 | 0·31 | 0·041 |
| Ditto white light .. | 348·0 | 304·5 | 23·2 | 7·6 | 6·66 | 602 | 760 | 0·46 | 0·031 |
| Alternating current arc lamp ... | 180·6 | 91·2 | 3·4 | 3·7 | 1·90 | 109 | 89 | 2·03 | 0·038 |
| Uviol mercury vapour lamp§ . . | 198·6 | 91·3 | 5·3 | 5·8 | 2·24 | 437 | 344 | 0·58 | 0·015 |
| Quartz lamp ... ... ... | 691·0 | 236·0 | 41·5 | 17·6 | 6·00 | 3400 | 2960 | 0·23 | 0·014 |

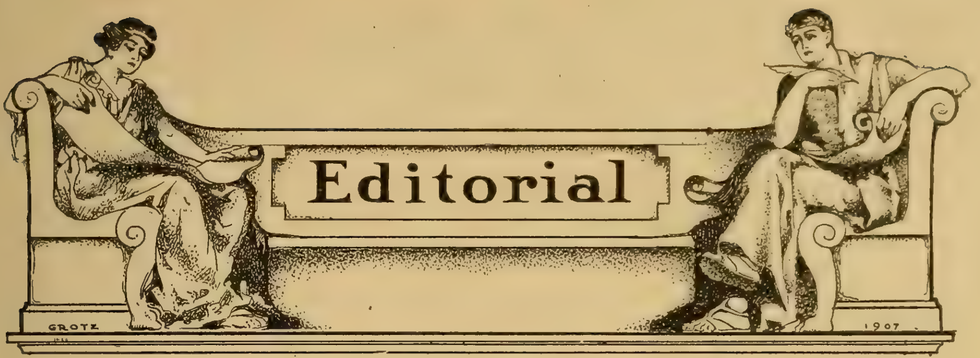
* Consumption of petroleum per hour, 39·73 grammes; heat of combustion of the petroleum, 11050 gr. cal. The total radiation was measured without chimney.

† Consumption per hour, 7·2 litres; heat of combustion, 13900 gr. cal. per litre.

‡ In calculating the total radiation, the absorption by the glass globe, amounting to about 15·5 per cent., was not estimated.

§ Uviol lamp of Schott & Gen., about 90 cms. long; average P.D., 63 volts; average current, 3·3 amperes For the average spherical luminous intensity the formula $J_o = \frac{\pi}{4} J_h$ was employed. The value of the total radiation is surprisingly low compared with the consumption of energy. This is probably due to a great proportion of the energy expended being used in vaporising the mercury.

* The above table was inadvertently omitted from the article by Dr. Lux in the April issue.




## Spectacular Lighting from the Esthetic Viewpoint

Is spectacular lighting, as commonly carried out in the way of electric signs and outline lighting, contrary to the essential elements of "the City Beautiful?" This important question is just now particularly agitating the various interests in the city of Rochester, N. Y. Rochester in the old days was known as the "flour city," and when robbed of that title by Minneapolis and St. Paul, it still retained the word, but spelled it "flower," a term which it has continued to use with propriety, not only on account of the large floral and nursery establishments connected with it, but also the general beauty of its residence section. The citizens are therefore very rightfully jealous of the reputation of their town for general cleanliness and beauty.

The question as to the general esthetic effect of electric signs and similar spectacular lighting has recently been brought to the front by the attempt on the part of those commercially interested in spectacular lighting to have the city ordinances so amended as to admit of electric signs being hung over the sidewalks. When the matter came before the City Council recently it was referred to the "City Beautiful" Committee of the Chamber of Commerce, which made the following report to the Law Committee which had the ordinance in charge:

An advertisement restriction which applies to all impartially works hardship upon none.

The street, from under-surface construction to the sky, is public property, and there should be great hesitation in relinquishing any portion of it to private ownership.

The beauty and dignity of the thoroughfare is very seriously menaced by signs projecting over the sidewalk, since these break the perspective, destroy vistas, and are aesthetically injurious to architectural façades.

In other prosperous and progressive cities such, for example, as Los Angeles, no projecting illuminated signs are permitted over the sidewalk.

Effective illumination, that will brighten the street and that will be beautiful instead of offensive, can be placed on the face of the building, and will be so placed if the projecting signs are prohibited. By such methods the business streets of Rochester could be made uniquely impressive, while the ordinance as proposed will invite a development which is expensive and commonplace at night and by day very disfiguring.

One of the councilmen suggested that there should be a regular committee appointed to pass upon the artistic merits of signs before permission was given for their installation. The question of having all public art officially censored opens up a very wide field for discussion—far too wide to venture on here. It reminds us, however, of a pictorial comment upon a certain organization of ladies in Ohio who sought to improve the esthetic appearance of their town. The purport of the cartoon is so characteristic that we venture to reproduce it.

Undoubtedly the projection of electric and other signs perpendicular to the façades of buildings and over the sidewlaks is a practice that can very readily lead to serious abuse; and the contention that such a practice, if allowed indiscriminate sway, would interfere with the "beauty and dignity of the thoroughfare" cannot be lightly put aside. On the other hand, the absolute prohibition of spectacular

lighting of this kind is also of very doubtful wisdom. Naturally, if allowed at all, it should be confined to the strictly business thoroughfares; but since there would be almost no occasion for its use elsewhere, this provision would take care of itself.

There are always certain sections in any city that are essentially commercial. They are the portions which naturally are most frequented, and all attempts to make them thoroughly attractive are not only legitimate but praiseworthy. The "Great White Way," in New York City, is the most shining example of this kind, and has become in a way a national institution. By day this particular stretch of Broadway is not especially attractive, but by night it is a thing of beauty and a joy till morning. The actual value, either based on rent or ownership, of the property in this section depends in no small measure upon the spectacular lighting at night.

The fact may be unfortunate, but fact it is, nevertheless, that the commercial centers in American cities have extremely little esthetic value from the architectural standpoint; they are generally an unspeakable conglomeration of heterogeneous incongruities. The electric sign only adds an element of interest to the puzzle.

There are some isolated cases in which it would be an artistic sacrilege to project electric signs from the front of a building; but taken by and large the general character of the present-day American business street is such that it is not an easy matter to make it less artistic. Such being the case, all means of rendering such streets more interesting and attractive are justifiable. On this subject the opinions of Mr. Rollin Hartt, as set forth in a most charming article in the Boston *Herald*, which was reprinted in the February issue of the ILLUMINATING ENGINEER, are worthy of most careful study. He brings out the fact very clearly that even lights which in themselves are garish or ugly may be so used as to produce, in connection with equally ugly surroundings, a night effect that is both striking and pleasing to the artistic sense.

Spectacular lighting is essentially a commercial proposition, and when confined to the strictly commercial quarters of cities, it is of unquestionable value, and any attempt to unduly restrict it must simply result in hampering the commercial growth and prosperity of the town. "The City Prosperous" is the necessary antecedent of "the City Beautiful."

## Is Electric Light Injurious to the Eyes?

The relation of artificial illumination to the increase in defective vision is a matter which is attracting more and more attention, especially on the part of those responsible for the lighting of schools. The school naturally affords a ready opportunity for the testing of eyes for visual defects, which accounts for the particular interest in the subject in connection with school children. Could similar tests be made on adults, taken at random, the proportion of defective eyes would doubtless be found to be even larger than with the children.

In seeking the cause for this really serious condition there has been a considerable tendency manifested to place the blame upon the electric light. The reasoning seems to be something like this: Defective eyes are much more common now than a couple of generations ago, especially in the larger cities; a couple of generations ago children did not have the electric light; therefore the electric light is responsible for defective vision. The argument is plausible, but the conclusion is subject to doubt; it may be only a case of coincidence. "Bob" Ingersoll once pointed out the fallacy of mistaking coincidence for cause by the following example: "Plug hats and suspenders are always found where the greatest enlightenment is prevalent, but it would be unsafe to conclude that plug hats and suspenders are the cause of the enlightenment."

In a paper read before the New York section of the Illuminating Engineering Society, Dr. H. H. Seabrook was particularly outspoken in his indictment against the electric lamp, the chief count being the comparatively large amount of violet and ultra-violet rays which it gives out. He says:

> "Spectral rays of sufficient intensity cause damage, but the blue, and still more the violet rays, are the really harmful ones. Our country leads the world in the brilliancy of its artificial illumination, and certainly leads the world in ocular exhaustion, discomfort

and congestion. When gas came into general use, these troubles began to increase, and a further increase was in evidence as the incandescent electric lamp came more and more into fashion. Both here and abroad oculists agree that the kerosene burner is the least harmful artificial illuminant. The image of the brilliant filament of the incandescent lamp, with its concentration of light, must harm the retina more than the more diffuse images of flames. . . . In concluding, lights weak in chemical rays are better suited to the eyes than others. . . . Take the spectrum of daylight through a window, and that of kerosene, Argande, Welsbach and incandescent electric lamps from just where you would sit to use them for near work; see what shade of amber yellow glass it takes to cut off the blue and violet rays, and you will find under those conditions the kerosene burner at one end of the list and the incandescent filament at the other."

In other words, the kerosene burner is the best and the incandescent electric lamp the worst for the eyes.

Dr. Louis Bell, who is a Doctor of Philosophy and not of medicine, but withall very competent to pass opinions upon the physiology of vision, in his discussion of Dr. Seabrook's paper, says:

"It is to be noted that the blue rays have frequently been regarded as unpleasant and harmful. How far that is true with modern intensities, I do not know. There is every reason to believe that ultra-violet, unless it is intense, is not particularly dangerous, although it can produce very bad results. Common daylight, everywhere agreed upon as by far the most comfortable light, is enormously richer in proportion of blue and ultra-violet radiation than any artificial light, save that from the quartz mercurial arc, or the Finsen lamp, or possibly the titaneum arc; so that a moderate amount of blue rays can hardly be considered injurious."

In a paper on "Eyesight and Artificial Illumination," by Dr. John T. Krall, read before the Philadelphia Section, the conclusions reached are also at variance with those of Dr. Seabrook. After calling attention to the fact that notwithstanding the many and careful experiments that have been carried on to determine the nature of vision, its mystery has not been explained, nor even lessened, Dr. Krall says:

"The red and violet ends of the spectrum are ineffective in vision, and consequently must produce very little photo-chemical change in the retina. The danger of any source of light, therefore, lies not in the peculiarities of radiation, but rather in its excessive brilliancy. . . . Kerosene lamps, candles, etc., never produce over-stimulation, as they possess only a few candle power per square inch against some hundreds in arc and high-efficiency incandescent lamps. . . . Many authorities on diseases of the eye would have us go back to the feeble candle or the but slightly better kerosene lamp of our ancestors because of that terrible bugaboo, ultra-violet ray, X-ray, or some other obscure radiation. . . . The electric lamp is the best source of illumination, so far as eyesight is concerned, that is offered at the present time. . . . It is condemned by many writers without just cause because someone considered as authority conceived a dislike for it and advised against its use, and the next man writing upon the subject accepts the authority and passes it along without going to the trouble to find out for himself. . . . The electric lamp, properly used, is a perfectly harmless source of illumination. . . . The burden of proof that electric lighting is harmful to the eyesight rests upon its objectors, and they have not produced the evidence."

The old question, "who is to decide where doctors disagree?" carries with it the important fact that disagreement among doctors is a practice of long standing; but the question itself has never been satisfactorily answered. In the present case, however, such points as the doctors do agree upon may be accepted as true with a reasonable degree of assurance. That excessive brilliancy, either of the illuminated surface or the intrinsic brightness of the light-source is harmful to the eyesight, is accepted alike by doctors, oculists and illuminating engineers, and unquestionably constitutes the greatest source of danger in modern illumination.

The whole trouble with the electric lamp arises from the manner in which it is used, rather than in the lamp itself. A flame produced either by gas or oil may be looked at directly or left in the line of vision with impunity, its intrinsic brilliancy not being sufficiently high to cause any ill effects, as ordinarily used. The filament of the incandescent electric lamp, however, is an entirely different affair and cannot be treated in the same way as a flame-source. At least ninety-nine out of every hundred persons confuse brilliancy

of the light-source with effective illumination, and look at the light instead of the objects which they want to see in attempting to form a judgment of the comparative merits of different systems of lighting. There is no more difficult nor more important work of education confronting illuminating engineers at the present time than that of disabusing the layman of this pernicious idea. So far as the light itself is concerned, as Dr. Krall says, no evidence has been produced, nor is likely to be produced, to prove that the rays from incandescent electric lamps are one whit more dangerous than those from candles or other flame-sources. Electric lamps are always enclosed in glass bulbs, and it is a well-known fact that glass absorbs to a very large degree the ultra-violet rays which are considered by some authorities so dangerous. The bare electric lamp, however, for near work, such as reading or writing, is always and everywhere to be condemned. The present tendency of the manufacturers of such lamps to furnish a complete lighting unit, consisting of some form of globe or reflector and a lamp having a bulb wholly or partly frosted so as to diffuse the light, cannot be too highly commended.

The electric lamp is one of the greatest achievements of modern science, and its use will continue to increase for years to come at approximately the remarkable ratio which it has shown in the past decade. There is no likelihood of a return to flame-sources, even for the most exacting eye work. But the electric lamp must be understood, and its light utilized in a manner to render it safe and hygienic to the eyes to the highest possible extent. To promote such knowledge and use is the duty alike of manufacturers, illuminating engineers, oculists, and the medical profession.

## The Electric Sign in Spectacular Lighting

What we have termed "spectacular lighting" has become, within the past year or two, a recognized institution in a large number of American cities. We have used the term to indicate the use of out-of-door lighting for the express purpose of attracting and holding attention to the lights themselves, rather than for purposes of illumination. Spectacular lighting, however, naturally and properly blends into the legitimate illumination provided for streets and general exterior use.

The fact that light can be used as a valuable adjunct to the other attractive features of a city was first demonstrated by those particularly progressive merchants who early realized the value of electric signs. From the simple formation of letters of light by rows of incandescent lamps, the electric sign has developed into a genuine work of art. In the combination of colors and an elaboration of design, some of the electric signs of the present time can rank with the spectacular effects produced in first-class theatres.

Much righteous indignation and waste of precious breath has been expended upon the artistic sins of the sign-makers. The origin of this outcry was more or less justified. The legend, "St.-1860-X," daubed in white letters upon an exposed face of rock, or the dilapidated side of a barn, was not particularly calculated to inspire the highest emotions of the esthetic sense; but some of the bill board displays of the present time have a greater influence in cultivating an appreciation of Art where such cultivation is most needed, than some of the art exhibitions that are proclaimed with loud éclat.

Bill board art is by no means to be generally despised; and there is a greater amount of native appreciation for what is good in Art than is commonly supposed. This fact was clearly demonstrated a few years ago in one of the large manufacturing cities in this country. A series of unusually large bill boards were put up along a section of a street in one of the slums of the town, which the aristocrats were unhappily obliged to pass through on their way from their business to their residences. The parties who controlled the signboards chanced to find a sign-painter of rare judgment and genuine artistic ability, and many of the signs were executed with a degree of skill and finish which would have done credit at least to the scenery in a first-class metropolitan theater. In no instance was one of these signs ever mutilated or defaced in the slightest degree by the native gamins of the street. Soon after the appearance of these signs, however, a competitor appeared who erected a few bill boards on the opposite side of the street; but lacking the judgment or the talent to equal the work of

the originator, he covered his boards with daubs. As a result, the paint was not yet dry when the gamins bespattered the boards with mud, and repeated the operations as fast as the painting was renewed. After a number of trials, the competitor wisely dropped out of the race.

An electric sign has comparatively little opportunity to be positively inartistic. The formation of letters outlined in light can neither be classed as artistic or inartistic. With the introduction of colored lights, an artistic element is brought in. There is no exhibition of color which is more fascinating than that involved in transparent objects; in fact, where transparency appears in Nature, it is hopeless for the painter to attempt to reproduce or even imitate it successfully.

Obviously, an electric sign can never be primarily an object of art, but it is as legitimately an object to which art can be applied as is a building. The more artistic the sign is made, the better it fulfills its utilitarian purpose—which is more than can be said of a good deal of applied art. On the whole, the electric sign is far more than the mere exponent or lure of its particular sponsor. It invariably and necessarily forms a part of the *tout ensemble*, or, as the American expresses it, "the whole toot," which makes up what we have called spectacular lighting. Every man, therefore, who hangs out an electric sign, is adding to the glory of his town.

## Modern Printing a Menace to the Eyes of School Children

We referred especially to the importance of this subject in our last issue, and it is gratifying to learn that the welfare of the eyes of public school pupils is being carefully considered by the Board of Education in New York City.

One point upon which stress is laid, and rightly so, is the tendency to use glazed paper in text books. The improvements, so-called, in printing and engraving have really been a retrogression so far as the effect upon the eyes is concerned. It was not long ago that all paper was dampened before being printed. This resulted in a slightly heavier impression from the type, and tended also to deaden any glaze or finish which the paper might have. Furthermore. illustrations were far less common, and when used consisted of comparatively coarse lines, as in the case of the primitive copper-plate and wood-cut. The result was a far more legible page, though perhaps less artistic than those produced by modern methods. The development of electro-typing and stereotyping, and more particularly of machine type-setting, has entirely done away with the old practice of dampening the paper, which was done to protect the type faces.

The chemical process of engraving, however, is responsible to a greater extent than any other single factor for the increasing use of papers with glazed and highly finished surfaces. The "half-tone," which is the technical term for the chemically engraved plate, is at present used almost exclusively for all the finer grades of illustrations. These two developments, namely machine type-setting and chemical engraving, have entirely revolutionized the printing art. A highly finished paper is an absolute necessity in the printing of half-tone plates; but such paper is not only exceedingly annoying to the eyes, since it must be viewed by light striking it at a particular angle, but is also contrary to the best artistic effecs, giving a hard and cold appearance. in addition to the obtrusive "vulgar gloss." The inventor who can devise an equally cheap method of producing pictorial effects with the same fidelity to detail and variations in light and shade, but which can be printed upon matte-surfaced paper, will be a real benefactor to the race. Fortunately, matte finished papers can be made materially cheaper than glazed papers, and there is consequently a tendency to use them for all printed matter in which half-tone illustrations are not required. The old book, with its rough and slightly yellowed paper, and its heavy type impressions, gives a certain feeling of ease in reading that our modern productions, with all their sharpness of detail, entirely lack.

The proposition of the Board of Education referred to, to have all text books, especially those for young children, printed on a soft or matte-surfaced paper, with illustrations in line drawing instead of half-tone, is certainly a move in the right direction.

## White Letters on Black Paper for General Reading Purposes

In a recent issue we published a short article by Mr. A. J. Marshall, setting forth the advantages from a physiological viewpoint of reversing the practice that has heretofore prevailed in printing, *i. e.*, of black letters on a white ground, and using white letters on a black ground. The point of the argument was that the surface of the printing being very much less than the surface of the paper, the eye would receive less total light if the print were made reflecting, instead of the paper, and by reason of this less quantity of light the eyes would perform less labor in reading. The proposition undoubtedly seemed chimerical to more or less of our readers, although the fact that it was really of serious import was recognized by a French technical journal, which printed a translation. Mr. Marshall argued purely from the physiological standpoint, having no reference whatever to the commercial or practical side of the problem. It is a curious fact that the same suggestion now comes from the paper manufacturers from purely commercial reasons. The question of paper has recently been receiving considerable public attention by reason of efforts to have the duty on wood pulp reduced or removed, with a view to reducing the cost. The practicability of making black paper seems to be assured. The difficulties of producing white ink which will give satisfactory results is, however, quite another matter, although it would be unsafe to say that it cannot be done.

The following special dispatch to the New York *World* from Appleton, Wis., gives the manufacturers' position in the matter:

Wisconsin manufacturers of print paper to-day put forth a proposition which, if adopted, will, it is said, revolutionize the print paper industry of the country and the newspaper industry as well. They propose that newspapers in the future be printed in white on black paper instead of in black on white paper, thus bringing about a saving of millions of dollars annually in pulp wood, assisting in the preservation of forests and reducing the price of news paper to about one half the present price.

Black paper can be made of old newspapers and almost any fibrous stock, while white paper requires spruce and hemlock wood. Wisconsin paper manufacturers will try to interest Eastern manufacturers and, if possible, bring about concerted action with the publishers of the country.

## New Lamps and New Fixtures

The fact that the new metallic filament lamps, at least those that have been thus far put upon the market, required to be used in a vertical position has set up a restriction, to a certain extent, in the design of electric fixtures. The ability of the carbon filament lamp to burn in any position lead to its frequent use on chandeliers and brackets inclined at various angles. This use may very likely have expressed the idea, if not the fact, that by pointing the lamp in a given direction the maximum amount of light and illumination would be delivered in that direction. In the very few cases in which reflectors were used this would hold true, but the practice was by no means limited to such cases. In view of the well-known fact that the carbon filament lamp gives its greatest intensity at right angles to its axis renders attempts to direct its maximum light by pointing the lamp in that direction sufficiently absurd. Except from the purely decorative point of view, the use of lamps in the vertical position, whether with base up or down, offers practically no restriction that will in the least hamper the illuminating results sought for. Given a definite flux of light and the manner of its natural distribution. and the illuminating engineer by the use of modern accessories can produce practically any distribution and resultant illumination required.

The special design of fixtures for use with the metallic filament lamps is an event which should be hailed with joy by all users of light, as well as those professionally interested in illumination; for while the designs thus far produced can scarcely be called revolutionary, the very fact of the existence of designs that have been worked out with a combination of illuminating engineering and artistic skill is full of promise for the general reform and improvement in fixture design for which there has been general and often loud clamour for some time.

# Correspondence

## From Our London Correspondent

There are not wanting signs in our great cities that during the next lighting season inverted incandescent gas burners will be adapted for street lamps extensively. At Manchester, although at present no inverted burners have yet been used to any great extent, experiments have been made with practically all types of burners fixed in the ordinary street lamps, but the opinion of the engineer, Mr. J. C. Newbigging, has been that the lighting effect is not so good as with the upright burner. We understand that experiments are being made with the Graetzin form of inverted lamp, and with this lamp considerable success has been obtained, so much so that its extensive use is very probable; in which case the lamps will be fixed on the top of the ordinary lamp columns in harp-shaped brackets which will, it is thought, add to the ornamental character of the street lamps. The London Metropolitan Gas Company is doing something in the way of using inverted burners on the street lamps; experiments are being carried out, but no definite scheme has so far been entered upon.

A report has just been issued, giving some valuable particulars in regard to the street lighting in the city of Liverpool. The street lamps are distributed over a district containing 455 miles of streets. The number of lamps lighted is 18,955, divided as follows:

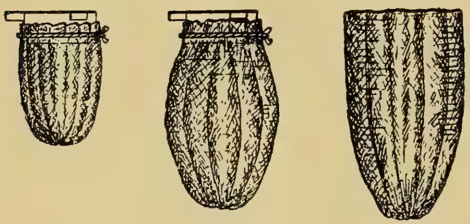
| Streets. | | Courts. | | Passages. | |
|---|---|---|---|---|---|
| Flat flame. | Incan. | Electric. | Flat flame. | Flat flame. | Incan. |
| 276 | 14,109 | 222 | 791 | 3,312 | 24 |

Gas is supplied to the municipality by the Liverpool United Gas Company at 2s. 3d (54 cents) per 1000 cubic feet; the total illumination in candle power value before midnight is 643,188, supplied at a cost of £47,780 ($228,344). In such a report there are, of course, interesting items. We gather that experiments are being made with Gunnung's system of automatically lighting and extinguishing street lamps; the committee has been so far satisfied that they have placed an order for 1000 of the lamps to be fitted up with the Gunnung automatic controllers. During the twelve months 236,000 visits were made by trimmers to incandescent lamps; the average number of lamps dealt with by each lamplighter is 111, in addition to lighting and extinguishing he has to put in time on lamp painting, etc. In Liverpool 440 miles of streets are lit by incandescent gas, 9¾ miles by flat-flame burners and 5⅛ by electricity.

We have just received a brief description of a new form of shadow photometer, which the inventor claims to be capable of giving extremely accurate readings. In this photometer a grating is used to cast the shadow. It has a narrow mesh, the wires being inclined at angles of 45 degrees to the vertical. The two sources of light that have to be compared are disposed at the same horizontal plane as the one on the vertically supported grating, while the one on the other side is a screen of matt glass. The light therefore casts a pair of images of the grating upon the screen, and the distance between the screen is so arranged that the individual bars of shadow are at the same distance apart. The angles at which the light rays impinge on the grating and the screen are also so arranged that the right eye of the observer is in the axis of the rays proceeding from the left-hand light, and the left eye in the axis of the light coming from the right-hand source. This causes each eye to see only one set of shadows distinctly, a stereoscopic effect being produced. When the two images coalesce, or become coincident, the observer seems to see a single set of

bars in space, the components of which appear to lie in different planes until the two lights have been so adjusted as to cast equal illumination upon the grating. With suitable reflecting mirrors, or prisms, the whole optical system can be fixed up on the ordinary bar photometer.

Inventive genius is exceedingly active in the field of gas illumination. We give illustrations (Fig. 1) of some corrugated mantles; these are thus described in the specification attached to the patent. The patentee proposes to form in the fabric or other substance, always before incineration, grooves, ridges, or indentations and excrescences or corrugations, arranged in any suitable way, and then incinerate the fabric. It is claimed that in addition to admitting of greater freedom in the expansion and contraction of the mantle, the form of construction will brace the mantle and render it stiffer and better able to resist shocks and blows. The illustrations



3. 2. 1.

FIG. I.

show the mantles subjected to and shaped by the process; (2) shows the mantle attached to a ring of magnesia, and (3) the completed mantle after incineration.

The automatic control of street lighting is receiving much attention, in several large towns experiments have been made, and in one or two systems are in practical and everyday operation. Mr. Sydney O. Stephenson, engineer of the Tipton Corporation gas undertaking, has been unremitting in his labors to establish automatic control of the lighting and extinguishing of the street lamps. We cannot in this letter give a full description of the system adopted, but hope at no very distant date to contribute an article upon the several systems which are in use in this country. Mr. Stephenson has adopted a pressure-worked system introduced by Messrs. Alder & Mackay, of Edinburg. The system is operated by a wave of pressure in excess of the maximum working pressure, which is given by manipulating the station governors at the works or by means of a pressure raising fan. The action of the wave of pressure upon the apparatus is to raise a bell which is connected up internally to the mechanism and thereby operated. The bell is weighted to overcome the maximum pressure, and it is only when the excess pressure is put on that the bell rises, and brings about the lighting or extinguishing of the lamps. During the fixing a pressure of about three-tenths in excess of the maximum working pressure was maintained and the bells were only weighted to just overcome this, the reason of this being to guard against any possible trouble afterward should the town pressure accidentally rise to the extent of one or two tenths. Mr. Stephenson has had the system at work for two years, and now the apparatus is fitted to practically all lamps in the district, numbering 456, of which 14 are refuge, or special, lamps. The success of the system is dependent upon the bye-passes keeping alight; the lanterns must be strong, and as nearly as possible wind-proof. The system may be adapted to flat-flame, inverted, or upright incandescent burners. The saving in labor is considerable, but the more direct economy is to be found in the reduction of consumption because of the instant control of the lighting and extinguishing of all burners and the great saving in mantle-rods and glasses. The following table shows the conditions obtained at Tipton in 1903-04-05 and the present reductions:

| Year. | Mantles. | Rods. | Glasses. |
|---|---|---|---|
| 1903 | 6.445 | 968. | 4.099 |
| 1904 | 6.806 | 858. | 2.891 |
| 1905 | 7.195 | 689. | 4.255 |
| 1907 | 4.508 | 333. | 2.248 |

The extra pressure needed should not exceed 1 inch, and in many towns this might well be reduced to 5-10 inch. The duration of the extra pressure may range from half a minute to a minute and a quarter. If consumers find the wave of pressure objectionable, burner governors should be resorted to. There is no doubt that the system is in every sense a practical solution of automatic control of public lighting.

From time to time we have called attention to methods devised to switch gas on and off much in the same manner as is done with the electric light, by means of a tumbler switch. M. H. E. Kelvey, an architect, has devised a new valve tube

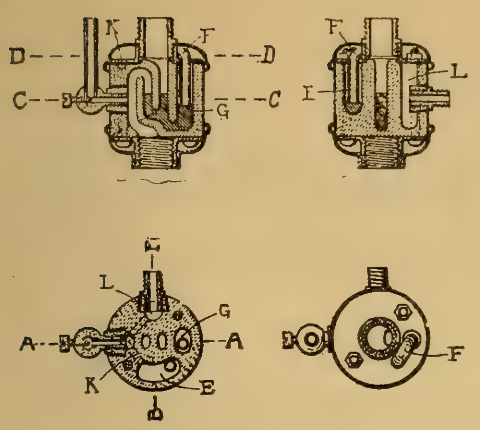



FIG. 2.

burner to control gas supply to the burner from a distance. The valve is actuated by mercury and is operated by pneumatic pressure, the tumbler or other switch being used. A very slight pressure is sufficient to operate this valve. Fig. 2 shows the construction and operation of the valve, which is intended to be screwed on below the burner. The valve is shown with the main gas passage sealed. The air pressure acts through the inverted U tube *F* and holds the mercury up in the seal. The chamber *E*, into which one leg of the U depends, is closed, but the chamber *G*, into which the other leg dips, is open to the atmosphere, so that there is no possibility of an excessive pressure being put on to blow out the seat, and excess of air simply blows away through *G*. When the air pressure is taken off the mercury falls back into the airtight chamber *E*, but there is always sufficient mercury to prevent any escape of gas through G; the intercepting chamber *I* prevents the mercury passing into the air tube by inserting a screw into the duct *K*, which connects *L* and *E*. The mercury is confined during the transit of the valve.

CHARLES W. HASTINGS.

## From Our Readers

The following letter was referred to in our editorial pages in the last issue, but was unintentionally omitted:

THE ILLUMINATING ENGINEER,
New York City.

GENTLEMEN:

In your March issue you have an article entitled "The Commercial Significance of the Tungsten Lamp." I wish to take issue with the writer of this article from the Central Station point of view. He seems to be half-hearted in his belief regarding the use of the Tungsten Lamp, as to whether the Central Station will adopt it, or be inclined to hamper its development. Having spent twenty years in the Electrical Industry, and my experience dating back to the 5 and 6 w.p.c. lamp, we welcome with delight the 3.5 and the 3.1, and I am positive that my brother central station operators will agree with me that the 1.3 or even the 1 w.p.c. lamp, is by far the best unit to use after the cost of production has been minimized. It is the experience of every Station Operator that the lower the price per k.w. hour or as we should say, the lower the price per lamp hour, the more satisfied are our patrons, and the greater is our revenue.

In one company, where the writer spent sixteen years, the price per k.w. hour was reduced during that period, from 18 cents to, in some instances, as low as 3 cents, and it is a fact that the net revenue of this company multiplied itself several times over. It is my opinion that in place of trying to educate the Central Station Men, the manufacturers should endeavor to build a lamp that will stand rougher handling, or when they give us a lamp that has life and a low consumption, they have solved one of the greatest problems in our business.

Sincerely yours,
FRANK C. WHITE,
Secretary and Manager.
Amarillo Water Light & Power Company, Amarillo, Texas.

# Commercial Engineering of Illumination


"There's Many a Slip"

# Before and After: An Object Lesson in Spectacular Lighting

There is an old saying about not missing the water until the well runs dry. The truth of this might be impressed upon city dwellers in a most convincing manner by shutting off the water supply, even for a few minutes. The same holds true in a scarcely less vital sense in the case of public lighting. We have become so accustomed not only to lighted, but to brilliantly lighted streets in the more frequented parts of town that we can hardly conceive what it would be to have them in darkness. The human species adapts itself to its environment quicker than any other known animal, especially if the change is in the way of increased comfort or pleasure. It is astonishing how quickly we can accustom ourselves to luxuries and come to consider them simple necessities. There was a time before streets were lighted at all, and yet people seemed to go their ways in some manner or other, and there were days before there were any electric signs, outlining, or other spectacular lighting, and still people existed.

In many cases has sprung up within so short a space of time that the days before it existed can be clearly recalled, and in imagination the difference between the old and the new be pictured. But to make this picture more vivid, it occurred to the manager of the electric lighting company in Scranton, Pa., to give an object lesson of this kind. The work of electrifying this city in the way of spectacular lighting has been carried out with such rapidity, vigor and success within the past year, that the principal business streets have been completely changed in appearance at night. In order to impress this fact upon the citizens, the simple scheme of turning off all this additional lighting for a short space of time was hit upon and carried out. A more impressive method of demonstrating what spectacular lighting does to give a city an air of gaiety and prosperity could not have been devised.

The following account of the results is from one of the Scranton dailies:

How it used to be in the central city at night before the energetic management of the Scranton Electric Company and the up-to-dateness of the city's merchants gave us a "Great White Way," was shown to thousands of persons who happened to be on the streets Saturday night when, promptly at 8.30 o'clock, all electric sign illumination went out and stayed out for a full minute before it was switched on again.

It was a free vaudeville stunt that was worth coming a good distance to see. The idea of the company was to show the people how dark it was before the introduction of the new business methods of the company when it came here a little over a year ago, and what has been accomplished in a comparatively short time. The results were remarkable, and it is doubtful if anybody would want to ever go back to a year ago.

It did not come to the company at the time it came here that it would be a good idea to take a picture before it got busy, but recognizing what a good thing it would be to show "Scranton before and after" it originated in the fertile mind of H. L. Doherty, president of the company and others, that the only way to do it would be to turn lights out for a while. So, when the hands recorded 8.30 o'clock on Saturday night, Manager George N. Tidd and Duncan T. Campbell, of the new business department, gave the signal for "lights out." Instantly the flood of lights in the various signs went out, and such a darkness—it was like an eclipse. The big crowd on the streets had read of the novel act in advance, but when, as the moment for "lights out" come a peculiar feeling swept over it. As if by an unknown impulse people stopped, stood still, wondered a moment and had hardly given expression to the wonderment of the whole thing when suddenly it was light again. The sixty seconds were gone. The contrast was striking, nay, vivid, and the lesson powerful in its impression. For the next hour it was: "Did you see the lights go out?" "Where were you?" "Great, wasn't it?"

Nothing could have served better to indicate the popularity of electricity and the progress being made in store illumination than the simple turning on and off of the switch.

LACKAWANNA AVENUE, SCRANTON, BEFORE THE INSTALLATION OF SPECTACULAR LIGHTING.


LACKAWANNA AVENUE, SCRANTON, AS IT APPEARS TO-DAY.

# A Lesson in Practical Illuminating Engineering as Picked Up by the Man on the Street

Illuminating engineering has been quite generally recognized as a valuable aid in the sale of both illuminants and illuminating apparatus, but the fact that it is not yet universally used is evidenced by the experience of a practical constructing illuminating engineer, as related below. The argument of the salesman is reported as nearly as possible in his exact words, and the illustrations are from his own pencil sketches made in the course of his "argument." He represented a lighting device especially adapted to show-window lighting, and no doubt thought himself particularly capable of discussing the problem.

"You illuminating engineers are in the wrong. You are trying to tell the people what they should have, and as a result you are practically up against it. Now take the matter of window lighting; the most successful manufacturer of window lighting devices has secured his present enviable position by making whatever contraption the owner of the window thinks is best.

"Now there is one basic principle which you illuminating engineers may know nothing of—water, air and light follow similar natural laws. Throw water against a wall and it splashes back to fall down in a splattering mass. Direct the stream against a curve, and the water will be directed along the line of the curve. Now take the case of glass with prisms, of which many are being sold. Put a lamp in a reflector of that character—what can you expect? The pockets fill up and you can't hope to get any kind of diffusion.

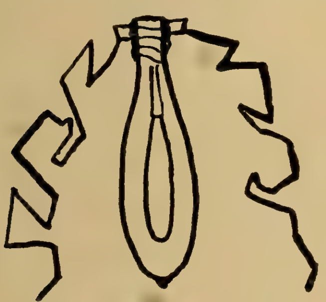


FIG. 1.

Take a window like this (see Fig. 2), and the light will take the direction shown. How can you expect to light a window that way? The thing *looks* as

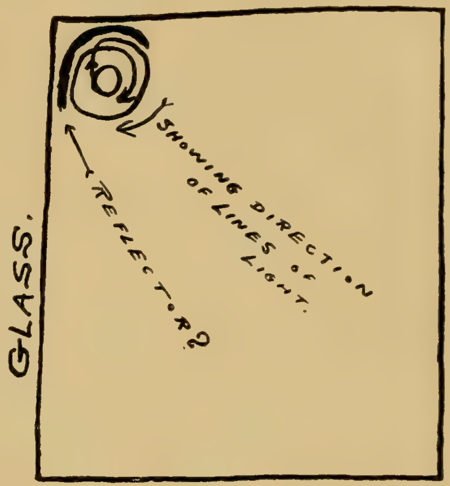



FIG. 2.

though it would do the work because it looks bright from the amount of light which is circling around the lamp, but you can see that the light which will spill over, and get down into the window, is very little. Now this would be the proper way to treat a window. For a white light you should paint the window white, for a red light use red paint or mahogany finish, with a weather oak finish or black paint you get——

"Now, to come to my idea: By using a trough like this (see Fig. 2), and having the back top corner of the window properly curved, you direct your light just as you would water from a hose, and it falls down the back of the window, quietly flowing out over the goods, and flooding them with light—*that's diffusion. That's* the way to properly light a window; and what is more, one-half the lamps you would use is all that would be necessary under this system. Some day I am going to prove it.

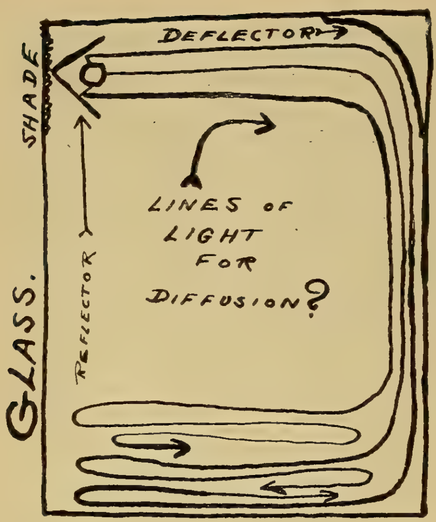



FIG. 3.

"No, I have not enough money to spare to make the change these hard times, but when I do I will let you know, and you can have a photograph taken of it. A photograph which will show the flow of light and the diffusion on the goods just the same as is shown in some of the pictures you have, only I can see that your's are photographs from pictures which have been painted and touched up to show the light in the way you would like to believe it looks.

"May I have those sketches?"

"Sure; take them along, and study them up; those are principles which you cannot afford to overlook."

## The Right Sign in the Right Place

"The up-to-date electric sign is a profitable investment," said the proprietor of a well-known down town restaurant to a representative of THE ILLUMINATING ENGINEER. "Look at my only sign. Here it is broad noon on a sunny day, and the way to this basement eating place is lighted by eighteen 16 c.p. lamps placed within the border of what might be termed a refrigerator filled with choice meats, vegetables, and fruit. Suppose I had put over the entrance to this basement entrance—my only entrance, in fact—the ordinary gilt lettered sign board bearing my name with the word 'restaurant' following; would that have amounted to anything as a trade puller? I guess not. I went to work in a different fashion. My problem was to attract attention to a narrow stairway—just 8 feet wide, to a basement in a building which is covered with signs, and the windows of whose ground floor stores are filled with elegant wares that attract the eyes of passers. Until I put in my electric sign few people except a number of regular customers knew there was a restaurant beneath this building. At first I thought of putting up a big arc lamp with a globe inscribed with my name and business. I called in an electrical engineer to talk things over. He said: 'Let me think the problem over for a day or two; then I will report.' In two days he came in with a drawing of a marble framed and plate glass fronted ice box to fit over the door to the basement. The picture showed a leg of lamb, a plate of sirloin steak, a bunch of celery, a pineapple and a platter of apples and oranges. Around the border were eighteen frosted 16 c.p. lamps. I took the drawing in my hand, walked out to the front of the building, looked at the dingy blank space just over my entrance, and pictured in my mind what a superb picture that drawing would be when worked into a handsome ice-box of marble and plate glass filled with appetizing meats and vegetables and fruits placed to hide that dingy wall space and all lighted up with electric lamps.

"'What do you think of it?' said the electrician.

"'Think,' said I, 'why, I think you are a past grand master of the art of hitting off good things to the king's taste—and you are my friend forever. Now you just come down stairs and be measured for the best steak with mushrooms and whatever else that's good in my place, and then you just rush around to your shop and hustle out that sign for me. The design and the price are right.'

"In ten days the sign was set up, and it has been from the beginning a big trade puller. Every day we see new customers. Nearly all speak to the cashier and say, 'that tempting display of viands in that cute little ice chest, if so it is, above the door, made me think that a place that showed such good food in the form of a signboard must be a good place for a meal.' As we live up to the samples shown, we are doing a very large increase in trade over the intake before the electric sign was placed at the entrance."

GEORGE WILLIAMS,
Commercial Engineer for H. L. Doherty & Co.

## Is There a Growth of Popular Interest in Illumination?

By George Williams.

There is, and plenty of proof of it without resorting to statistics.

The popular interest in anything is well worth a review, but this growth of popular interest in illumination demands a new consideration and action by those engaged in the lighting industry.

Fashions and customs of centuries have vanished with this demand for light. The stinting of illumination is distasteful and discourteous wherever practiced before people. This is true in the home, in the hall, in the store or in the school, in the community or in a municipality.

Commerce has removed the board shutter from the shop windows, decency and architecture has taken it from the dwelling, but it is this growing demand for light which prompted the revolution.

Popular interest in illumination has caused our plans of a few years ago to look niggardly. The wiring, piping and other lighting equipment is now inadequate for the requirements of the most desirable patronage. We provide for one lamp where ten will be demanded, and present propositions becoming a peanut stand rather than the big department store.

The public is in a receptive attitude for a higher standard of lighting. Decorative lighting was never so in approval as now, and the approval is gauged by the size and design of the displays.

There is something more to the lighting industry than the process of supplying the bare needs of public safety or of supplanting one form of illuminant with another, and in somewhat the degree that electricity has expanded the sphere of transportation, heat and power, so is illumination opening up new fields for itself.

There surely has never been a method of expressing a word or a message so effectively as by electricity. An advertisement is compelled to attract the eye, the ear, or both, or it is not advertising; the public favors that which attracts the eye and in this application of light, advertising is developing the greatest medium for dispelling darkness in the central city. Illumination has been stimulated in some cities more by enterprising advertisers than by those in the lighting business, the conception of many of the purchasers being broader than that of the salesman. Is this not proof of a growing demand? Many products could not thrive so well under such a process.

Another sign of the progress is the favorable comment excited in the press and among the traveling public whenever normal development of illumination takes place in a city. Traveling men can tell you where the new business departments are located. People still talk about the illuminations at the World's Fair. The recent illumination of the *World* Building in New York on the occasion of their twenty-fifth anniversary attracted 40,000 people from residence districts many miles away. The outlining of the New Singer Building tower attracts more attention than the Statue of Liberty, and the Great White Way has magnetized the world.

A popular demand for any product will soon support its literature and there has been a phenomenal increase in demand during the past year for journals which pertain to illumination. A magazine devoted to popular electricity was recently exploited and already has commanded a

market on the news stands. The literary magazines now frequently illustrate night views showing remarkable illuminations, and the advertising pages carry more in a single month's issue to advance lighting equipment than the total copy of that kind previous to 1900. In those pages we find the kerosene lamps still exploited and various types of lighting device; these do not flourish because they are preferable, but on account of the demand for light.

The success of many commodities even after a demand was made for them, was governed by the manner in which they were served up to the public. The industries and institutions which have arisen with the development of the automobile, the correspondence school, the office filing system, and the cash register, can all thank their promoters for existence. Utility and merit alone will not insure a sweeping success of the illumination arts, but the new business man will, if he is given support equal to that accorded any other commercial project which has been successful.

## Litigation in Regard to Flasher Patents

We recently received the following notice from the Reynolds Dull Flasher Company, at Chicago:

INJUNCTION NOTICE.

Judge Kohlsaat, in the United States Circuit Court, Northern District of Illinois, handed down an opinion on April 22, 1908, sustaining E. R. Dull's Sinclair patent, allowing injunction restraining Reynolds Electric Flasher Manufacturing Company at 191 Fifth Avenue, Chicago, from further manufacturing and selling what have heretofore been known as the "Reynolds" and "Reco" flashers. Dull's patents can be used only by Reynolds Dull Flasher Company, 152 Fifth Avenue, Chicago.

Fully appreciating that there are always two sides to a story, and especially to a law suit, we have sent a letter of inquiry to the Reynolds Electric Flasher Mfg. Company, in Chicago, to which we received the following reply:

The Illuminating Engineer,
New York.

Gentlemen: We are in receipt of your favor of the 1st inst., referring to the notice you received from Reynolds Dull Flasher Company, and thanking you for bringing this matter to our attention we take pleasure in stating the following:

We have issued a circular letter, which we have sent out to all our present and former customers, and of which we inclose herewith copy for your perusal.

You will see from this letter how the exact situation stands.

Very truly yours,
Reynolds Electric Flasher Mfg. Co.

Chicago, May 4, 1908.

Dear Sir: On April 22 a judgment was rendered in the Circuit Court of this city restraining us from the further manufacture of the Reco and Improved Reynolds Flashers. This decision was reached in consideration of the fact that our type of flashers had embodied certain parts protected by a patent granted in 1896.

Although we have always felt that our devices were no infringements, but the result of many years of careful and costly experimenting, we are neither surprised nor handicapped at this decision of the court.

On the contrary we have well provided ourselves for this event, and we have a flashing device that is superior to our previous flashers and to those of any competitor.

This flasher we have named the "New Reco." The New Reco is now on the market, and cuts and explanations of its superior features will be mailed you as soon as the photolithographer and printer have done their work.

In the decision of Judge Kohlsaat of the United States Circuit Court he gives us full credit of re-inventing the Sinclair device, without having seen or heard of the Sinclair patent. He also gives us due credit for having made the electric flasher a commercial machine, and for resurrecting the patent from its burial in the tomes of the Patent Office.

There is therefore not the slightest reason for our friends to be alarmed. Nothing has been changed in the course of our business, and we shall continue to make every effort to justify the confidence our friends have always been kind enough to place in us.

Thanking you for past favors, and trusting that you will kindly and justly appeciate the situation and again favor us with your valued orders, we thank you for your consideration and beg to remain.

## A Commendable Example of Commercial Illuminating Engineering

Those who have looked upon illuminating engineering simply as a theoretical science, of value only as a topic for academic discussion, will do well to observe the extent to which it is being practically applied in the commercial field, a noteworthy instance of which is furnished by the National X-Ray Reflector Company, of Chicago. We have had occasion heretofore to mention the excellent products turned out by this company, and it is gratifying to learn that they are utilizing the principles of illuminating engineering quite as fully in the sale of their particular line of goods, as they are in the design and construction of their apparatus. The following is a copy of the form of proposition which they regularly submit to all prospective customers. We give it simply as an example of the commercial application of illuminating engineering, without prejudice to the merits of their own or any other type of reflectors.

Chicago, 190

Gentlemen:

The table below shows saving to be obtained by using reflectors and Gem high efficiency or lamps in of your show windows in place of old style inefficient devices and old style 16 or 32 candle power carbon filament lamps.

While only an estimate, the table is very conservative and the installations using our reflectors will give you at least an illumination equal to the old style; in fact, appreciating that brilliantly lighted windows are of the greatest importance, we have specified a sufficient number of lamps to more than equal the illumination obtained at a greater cost with old style equipment.

| | Present Installation | Poke Bonnets with ordinary 16-c. p. Carbon Filament Lamps | Helmets / Poke Bonnets with Gem-High Efficiency Lamps | Helmets / Poke Bonnets with Tungsten / Tantalum Lamps |
|---|---|---|---|---|
| Number of Lamps used | | | | |
| Initial candle power per Lamp | | | | |
| Total initial candle power | | | | |
| Watt consumption per Lamp per hour | | | | |
| Total watt consumption per hour | | | | |
| Total kilowatt consumption per year | | | | |
| Cost of current per kilowatt | | | | |
| Cost of current per year | | | | |
| Cost of Lamps, each | | | | |
| Cost of Lamps per year | | | | |
| Total maintainance cost per year | | | | |

## Personal Paragraphs

The extensive new quarters of the Electric Motor & Equipment Company have been opened for business at 232 Market Street, Newark. There the company has almost 20,000 square feet of floor, which will be given up considerably for the display of various types of incandescent lamps which are made by the General Electric Company, the Electric Motor & Equipment Company, being the sole agents for the Edison lamps.

Mr. S. H. M. Agens, manager, has up-to-date ideas regarding the exhibition of lighting fixtures. He believes that confusion in display should be avoided, and to that end he has partitioned off separate rooms, fully furnished, into which he may induce possible purchasers to the end that he may show them what the fixtures will look like when properly installed amid proper surroundings. The company will be the representatives for New Jersey for the Cleveland Gas & Electric Fixture Company. In addition to lighting fixtures, the company manufactures a full line of electrically illuminated signs and patriotic and society emblems, sign-flashers, time switches, photometers, stage-foot and billboard reflectors. The plant will include a well-equipped electrical machine established for its manufacturing and for general repair work.

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The business interests of the H. W. Johns-Manville Company, in the city of Detroit and the territory adjacent thereto, have increased to such an extent that a new branch is about to be opened by that company. This branch will be located at No. 72 Jefferson Avenue, Detroit, under the management of Mr. Willard K. Bush. Mr. Bush is well and favorably known throughout that section of the country, having been connected with the Milwaukee branch of the company for a number of years. The company will carry a complete stock of goods at the Detroit branch, so that shipments can ordinarily be made direct from Detroit stock.

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Mr. H. R. Fothergill, M. E., formerly of Philadelphia, Pa., and Wilmington, Del., has resigned as Genl. Supt. Greenville Traction Company, Supt. Greenville Gas & Electric Light & Power Company, Supt. Paris Mountain Water Company, properties located in Greenville, S. C., and owned by American Pipe Manufacturing Company, of Philadelphia, to become engineer and manager of the Scholl Engineering Company, entering the field in the allied lines in which Mr. Fothergill is an expert.

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The Excello Arc Lamp Company has moved to 30-32 East Twentieth Street, and their Mr. Hirshberger has fitted up some very attractive show-rooms and offices. On the street floor are the show-rooms and sales department; and the basement has been equipped by the company for the mechanical details of the business.

The District Office maintained by Allis-Chalmers at San Francisco in charge of Mr. H. D. Scribner, manager, has been removed from the Atlas Building to the Phillips Building, 599 Mission Street. As it is only a step from one building to the other, callers will have no difficulty in finding the new location.

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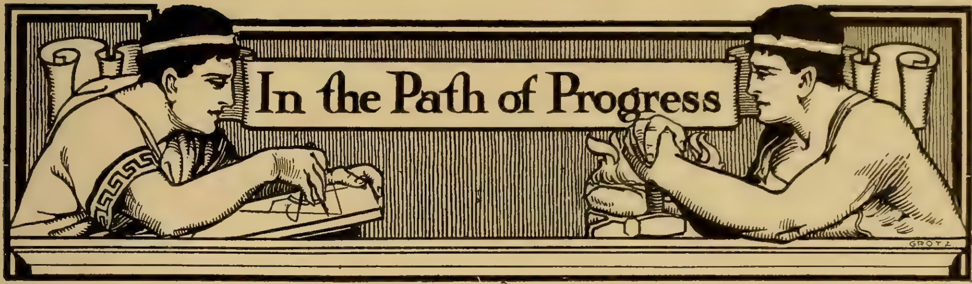
Complaint was filed in the United States Circuit Court in New York by the Westinghouse Electric & Mfg. Company against the Beck Flaming Arc Lamp Company of New York, for infringement of the Bremer patents covering the manufacture of Flaming Arc Lamps. Similar action will shortly be taken against other infringements as the Bremer patents owned by the Westinghouse Electric & Mfg. Company are basic on this type of lamps.




## A New Cluster Unit

Large *vs.* small units is a question that has been much discussed by illuminating engineers, and so far without any general agreement as to results. Both have their advantages and their place in illumination, and the aggregation of small units, such as incandescent electric lamps, to form single units, as in the case of chandeliers and clusters, is a practice that seems likely to continue without diminution. Even the commercial advent of the higher power, higher efficiency incandescent lamps, does not seem destined to preclude the use of clusters. The multiple socket, which is commercially known by what seems to us a rather clumsy name, the "wireless cluster," with its adoption of special reflectors, has produced a type of unit which combines a very high degree of illuminating efficiency with simplicity and cheapness of construction, and a fairly artistic appearance. The necessity, however, of placing the metallic filament lamps in a vertical position has required a re-construction of these units. The Benjamin Electric Manufacturing Company, which is chiefly responsible for the introduction and enormously extended use of cluster units, has, according to its usual practice of being in the lead, brought out a special form of cluster adapted to the use of metallic filament lamps in their required position. The illustration gives a clear idea of its general design. The cluster measures 25 inches over all, and consists of $\frac{3}{8}$-inch pipe, with $\frac{3}{4}$-inch casing, crowfoot, top canopy, cluster body, 18-inch opal reflector, and wiring connections. The brass base is covered with a frosted aluminum reflector; the unit is furnished for four, five and six lights, either with or without the center lamp, and with or without pendant switch. It is symmetrical in outline, and pleasing in appearance, and affords an effective, convenient and economical fixture for public lighting purposes.


BENJAMIN CLUSTER FOR TUNGSTEN LAMPS.

## The Daniels' Boulevard Lighting System

The readers of THE ILLUMINATING ENGINEER will probably be interested in a new specialty which has recently been placed on the market by the Jandus Company—the Daniels' Boulevard Lighting System.

As indicated by the accompanying figure, each unit of the Boulevard Lighting System consists of a reinforced concrete base, shaft and capital of Ionic design, the whole surmounted by a complete arc lamp mechanism enclosed within a twenty-inch opal glass ball globe. The system has been designed to operate on multiple direct current, multiple alternating cur-

rent and series alternating current circuits, and is, therefore, especially adapted for use either in city business quarters, where direct current is usually furnished or in residence and outlying districts where alternating current is in use. The lighting of boulevards, parks, public squares, public buildings, capitol grounds, business blocks, private drives, amusement parks and many other applications fall within the sphere of the Boulevard Lamp.

During the development of this system many experiments were made with both iron and concrete posts, but concrete seems so admirably adapted to this particular service that several standard designs have been adopted by the Jandus Electric Company. However, cast iron supports are often recommended and can

be furnished when desired. The concrete posts are moulded and finished to correspond to sandstone, marble or granite—in fact, any natural stone or marble finish, ranging in color from deep gray to pure white. They are practically indestructible and are much more artistic than painted jib or goose-neck supports, whose presence by day produces discord in otherwise harmonious surroundings and which also require frequent applications of paint to preserve their integrity. The concrete column will not oxidize or deteriorate under the worst atmospheric conditions and the cost is so reasonable that the system has been applied economically to ordinary street lighting. Heretofore iron and wood have been the only materials available for electric lamp posts, gas lamp supports, park seats, railings and the like, but as neither of these materials can be successfully treated for outdoor work in its natural finish, there is always a suggestion of artificiality. Owing to its susceptibility to any natural finish, concrete can be made to harmonize with any outdoor surroundings — buildings, walks, curb, street paving, etc. Even among trees and flowers the stone finish seems more in keeping with its environments than any other material.

The lamp structure is a slight modification of the well known Jandus Fig. 80 type, the only alteration necessary being to shorten the mechanism. Even though somewhat shorter than the regular type of lamp, it is possible to use a nine-inch upper carbon and a four-inch lower carbon, which together with the use of the Jandus patented diffusion chamber, insures an average life of one hundred and twenty-five hours per trim. The lamps are of the so-called enclosed type and are fitted with light opal inner globes and completely surrounded by twenty-inch opal glass balls. The large globe insures perfect diffusion, entirely eliminates the glare of the arc, and produces a quality of light heretofore unequalled.

We are sending you under separate cover an electrotype of a single unit of the Boulevard Lighting system, which you might want to use with our short write-up.

## A New Reflector

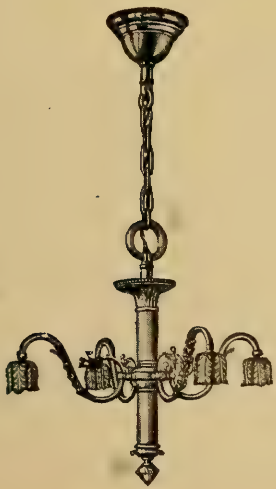
A new reflector unit of the trough type has been designed by that veteran reflector manufacturer, Nelson Weeks, of New York. An end view of this reflector is shown in the accompanying cut. The reflector is longer than would appear from the cut, however, being designed to take two standard incandescent lamps in a horizontal position. As will be seen, the reflecting surface is parabolic in outline, and is made of corrugated glass, silvered, which gives a very high reflecting power. A novel feature of this reflector, which is protected by patent, is the use of a plug fitting the ordinary receptacle and attached to the reflector by a swivel joint, so that the light may be directed in any desired location. Fitted with two 16 c.p. carbon filament lamps, it gives a maximum intensity of 125 c.p. It should prove

a very useful device for the lighting of show-windows, pictures, etc., especially in the case where receptacles are already installed, in which case no additional wiring is required, but simply screwing the attachment plug into the receptacle and placing the lamps in position in the reflector.

## Fixtures for Tungsten Lamps

The desirability, if not the actual necessity, of constructing fixtures especially designed for the use of the new high efficiency lamps is noted elsewhere in this

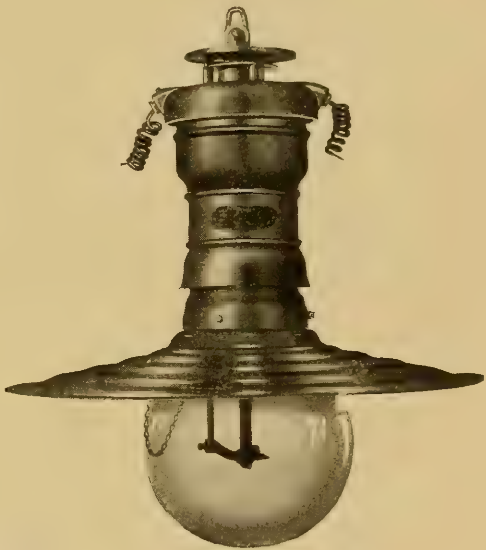
issue. Among those who have recognized this necessity, and come to the front with suitable designs must be included the Dale Company, of New York. One of their designs, which will appeal to the general user for its simplicity, graceful lines and purely electrical appearance is shown in the illustration. This, however, is only one of many equally good designs which are fully illustrated in their catalogues. The prices are said to be as attractive as the designs.



## A Multiple Luminous Arc Lamp

The luminous metallic arc is now recognized as the most efficient and best all-around street illumination in commercial use. This system of street lighting having passed the experimental stage, is now in quite general use. For low voltage, direct current multiple circuits, however, there has been but little use made of the luminous arc lamp.

The General Electric Company has now on the market a luminous arc lamp for operation in multiple on direct current circuits of from 100 to 125 volts. The



general form of this lamp can be seen by referring to Fig. 1. The casing is of solid copper with a black oxidized finish and of sufficient thickness to form a durable housing for the lamp mechanism, as well as a substantial support for the outer globe and its supporting ring.

Figure 2 is an interior view, showing the mechanical construction of the lamp. The main frame consists of a 1½ inch iron pipe connecting the top and bottom castings. This method gives a rigid construction and at the same time provides a suitable center draft or chimney for disposal of the arc fumes. At the top this chimney is protected from rain and snow in such a manner as not to interfere in any way with the natural and uniform draught required for the proper action of the arc.

The upper or positive electrode consists of a drop forging of copper. With a large volume of copper and a large radiating surface, it is possible to keep this electrode at a low temperature. This condition together with the peculiar characteristics of the luminous arc, results in a slow wearing away of the copper. The copper electrode in a 4 ampere lamp will require renewal after about 1,800 hours' operation; or with an average burning of 5 hours per day will last about one year.

The lower electrode which is responsible for the flaming characteristic of this lamp, is an iron tube about ¾ inch in diameter filled with a prepared composition. One electrode only is used at each trimming, with a life of about 150 hours.

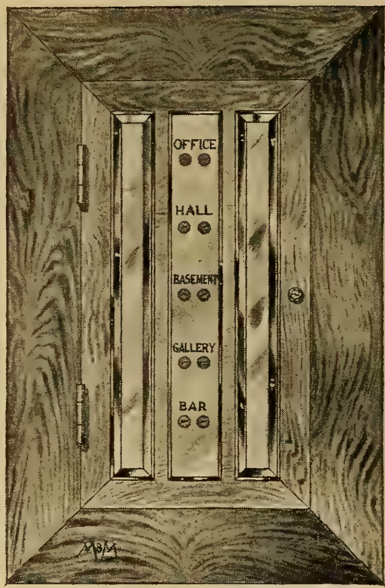
There are two single magnets, with two armatures mechanically connected. The action is positive and at the same time remarkably sensitive, responding quickly to any variations of the line or arc, and thus maintaining a close regulation of the current.

Figure 3 shows a comparison of photometric measurements of a 5 ampere D. C. enclosed arc, a 7.0 ampere A. C. enclosed arc and a 4 ampere magnetite arc. Even with the decreased wattage the increased candlepower, as shown by the outer curve, is noticeable. The characteristic distribution of the luminous arc, with its maximum intensity near the horizontal, is well known. This natural distribution can be changed to meet other street lighting requirements by the use of correctly designed concentric wave reflectors.

In general, the lamp needs little attention; less, in fact, than the enclosed lamp, as there are no enclosing globes and gas caps to require careful haindling, cleaning and renewing. The luminous arc lamp is specially recommended for the lighting of foundries, machine shops, train sheds, freight houses, drill halls and riding academies.

## An Improved Panel Board

A new type of Panel Board has recently been placed on the market by the Machen & Mayer Electrical Mfg. Company, of Philadelphia, Pa., which embodies a number of important improvements in panel




board construction. The switches used on these panel boards are of either the Push Button or Lock Switch, quick make-and-break type. As all live parts of the switch are covered up, the buttons merely extending through the face plate, there is no danger of the operator coming in contact with live parts as with knife switches on the ordinary panels. The face plates which cover the switches serve as a convenient directory of the various circuits, as the names of the circuits can be engraved over each switch. Where panel boards are located in hallways, in public buildings, or in places where it is desirable to have the lighting circuits under the control of some special attendant, lock switches are used, which can only be operated by a key specially designed for the purpose. With the flush type of panel it is unnecessary to open any door to operate the switches, either of the Push Button or Lock Switch type, the door being opened only when a blown fuse is replaced. The Underwriters' specifications are followed in every respect in the construction of these panel boards, and the "M. & M." Shallowest Flush Push Button Switches used in their construction have been tested by the Underwriters and are approved by them. Patents have been applied for covering these panel boards. A catalogue illustrating and listing this line is now ready for distribution.

DRY GOODS STORE LIGHTED BY GRANT FLAME ARC LAMPS WITH WHITE CARBONS.

## A New Flaming Arc Lamp

The Grant Flaming Arc Lamp manufactured by the German American Electric Company of New York is one of the latest types of arc lamps put on the market, and embodies features of simplicity in its construction not found in any of the existing types. The lamp is of gravity feed type, requires no clockwork, gears, clutches, shunt coils, dashpots, or resistances, but feeds the carbons by gravity only. The solenoid is provided with a floating plunger so adjusted that when the lamp operates under the proper voltage, it will separate the carbons to a given distance, and consume the amount of current for which they are designed, using the resistance between the carbons or of the arc instead of the resistance so well-known in other arc lamps. On account of this arrangement, the voltage across the arc is just one-half of the line voltage, providing two lamps are connected in series, without any loss of current which may be used up in resistance in other arc lamps. This offers several advantages: First, it produces a higher voltage across the arc, or, in other words, more pressure, which enlarges the flame materially, and gives more light on that account; second, it converts none of the current into heat, which would be the case providing resistance was used, and thereby is keeping the lamp considerably cooler on that account. Any variation in the line voltage which may occur from time to time, as the lamps are burning, is taken up in the solenoid as it attracts the plunger more or less, as the case may be, thereby changing the size of the arc which governs the operation of the lamp. A very novel feature presents itself in the feed of the carbons, which is controlled by a lateral support and so arranged that as the carbons burn away underneath the support, the negative carbon which is supported in this manner deteriorates sufficiently on account of the heat to allow the carbon to feed when necessary. Having no obstruction below the arc, the lamps furnish the full efficiency of the light possible. The frame of this lamp consists of a top and bottom held by four substantial rods and one additional rod in the middle to allow a traveler to guide the carbon-holders down properly. The lamp itself is 26 inches only, and is in a position to carry 24 inches carbon, and weighs but 20 pounds. It is found to be of great advantage in a great many places where the ceilings are not extremely high, as it gives the lamp a chance to diffuse the light properly.

## The Sargent Gas Calorimeter

Our London correspondent described quite fully in our last issue a new form of gas calorimeter which has been brought out in England, and we called attention to the fact that, since the calorific power of gas is the logical basis for its commercial rating, the subject of gas calorimetry is one with which the illuminating engineer must familiarize himself.

The following description of a calorimeter recently brought out in this country will therefore be of interest. The instrument is known as the Sargent Gas Calorimeter, and is manufactured by the Sargent Steam Meter Company, of Chicago, to whom we are entitled for the description and illustration:

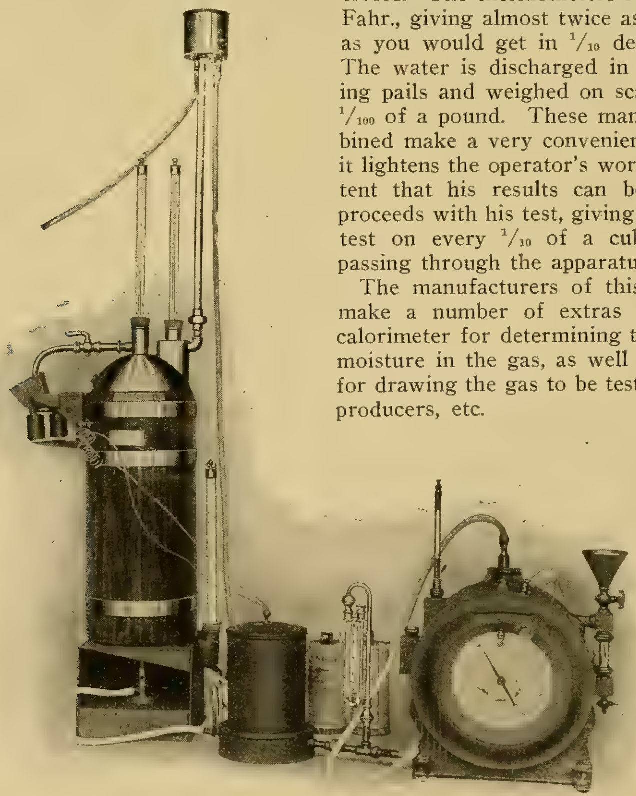
In building the Sargent Gas Calorimeter the accuracy of the apparatus and convenience of operation have been taken into consideration. The cold water entering the calorimeter envelopes the warm water; therefore, all radiated heat is carried back into the center, and none of this heat is lost. The base is also well inclosed so the operator will find there is absolutely no downward radiation of heat from the burner. The cold water is also inclosed in a jacket of wood lagging and asbestos, practically eliminating the possibility of absorption of heat from the air of the room.

Either a wet or dry pressure regulator is furnished with the apparatus, both being guaranteed to be very sensitive.

The Gas meter is of the best construction, being well braced throughout. It is furnished with a thermometer and manometer; it is also supported on three legs fitted with leveling screws. The Calorimeter, Pressure Regulator and Gas Meter are built entirely of heavy copper and brass.

The advantage of using this apparatus is easily seen by engineers who are familiar with the operation of one of these devices. The Automatic Dumping Bucket which takes care of the switching of the water from one receptacle to the other relieves the operator's duties to a great extent, giving him more time to devote to thermometer readings and also excluding a great many of the personal errors. The thermometers read in $^1/_{10}$ degree Fahr., giving almost twice as close a reading as you would get in $^1/_{10}$ degree Centigrade. The water is discharged in balanced receiving pails and weighed on scales weighing to $^1/_{100}$ of a pound. These many features combined make a very convenient apparatus, for it lightens the operator's work to such an extent that his results can be figured as he proceeds with his test, giving him an accurate test on every $^1/_{10}$ of a cubic foot of gas passing through the apparatus.

The manufacturers of this apparatus also make a number of extras to go with the calorimeter for determining the dust, tar and moisture in the gas, as well as an apparatus for drawing the gas to be tested from suction producers, etc.




# American Items

How Color of Walls Affects the Cost of Lighting, by W. J. Clarke, *Gas Logic.*

The article takes up the well-known fact that the ordinary wall papers absorb varying amounts of light falling upon them, and traces out the money values involved by this absorption. The economical view of the matter, as it affects the lighting companies is thus set forth:

We will cite a case of how the living costs are affected by the wall coverings. A family moves into a new house, where the walls are of a white alabaster finish, and for the first year no change is made in their surface, as the owner wishes the house to dry out and settle before painting or papering. The same family continues to occupy the premises a second year and the owner consents to paper the rooms—the selection of paper is left to the tenant and his taste, perhaps, runs to the dark colors and somber tones. He has the rooms which are most frequently used hung in dark reds or greens, colors which are lowest in reflecting properties and which absorb about all of the light thrown upon them, with the result that where formerly one or two burners were sufficient to light the room satisfactorily, now three or four are required. Complaint is made to the gas company of the increase in the lighting bill and the argument advanced that the family are the same in number as last year and the manner of living is unchanged, the same rooms are occupied about the same number of hours by the same people; and all of this is actually so. But the factor which enters most largely into the increased cost is entirely overlooked, and it remains for the lighting company, by a series of cross-questioning, to bring out the important fact of the change in the color scheme of the rooms. This oversight is the more curious, since everybody understands well enough the "bright, cheerful effect" of a light wall paper. Even those who prefer the dark papers easily recognize the difference in tone between a room papered in dark olive green and one with a light paper.

Street-Lighting in Philadelphia, by H. Thurston Owens, *Progressive Age.*

Illustrated article showing various types of lamps used in Philadelphia street-lighting. The article brings out some curious and interesting data in regard to street-lighting in general, and Philadelphia in particular.

The following statistics are interesting: The number of public lamps and the prices, on January 1, 1908, were as follows:

| | |
|---|---|
| Electric arc lamps, 12,018 | $100.06 |
| Open flame gas lamps, 22,224 | Free. |
| Mantle naphtha lamps, 14,432 | 29.00 |

The free gas lamps are, on the face of it, a puzzling item, but it appears that they are furnished under a franchise granted to the United Gas Improvement Company, apparently in consideration of valuable privileges covered by the franchise.

Lighting of a Small Chicago Church, *Electrical World.*

An illustrated article describing a somewhat novel system of lighting recently installed in a small church in the suburbs of Chicago. The installation was laid out by an illuminating engineer in compliance with the architect's ideas as to its artistic expression. The result is apparently highly successful from both the engineering and architectural standpoint. A notable feature is the use of chandeliers constructed of wood, of a design to harmonize with the ceiling, which was of wood construction showing the timber work complete.

# Foreign Items

Compiled by Alfred A. Wohlauer.

1. Electric Incandescent Lamps.

In the Current Topics of *Electricity*, April 24, 1908, "Elektron" says that "he thought that the carbon lamp would show more fight as soon as it was really threatened by the new comer." It must be admitted that the new comer, the metallic filament lamp, is really menacing the prestige of the carbon lamp, but undoubtedly the latter offers resistance not only by its cheapness and mechanical perfection, but is slowly getting ready to defend itself by means of increased efficiency; and nobody can tell who is going to win in the end, as the melting point of carbon is considered higher than that of Tungsten.

So we read in the very complete review under the title of "Fortschritte in der Glühlampen-Industrie" (progerss in the incandescent lamp industry), which is continued in the *Zeitschrift für Beleuchtungswesen,* March 30, April 10 and 20, that graphite of the lowest specific resistance is squirted into filaments in a similar way as Tungsten; lamps containing such filaments are said to have a specific energy consumption of 1 to 1.5 watts per candle and a life of 500 to 600 hours. This would confirm a suggestion the present writer made to Mr. E. G. Acheson about a year ago.

Of special interest among the numerous data in the above review is a scheme suggested by Joh. Lux, for testing the quality of metal filaments before they are placed in the lamp. As all the metals oxidize and discolor when heated up to a certain degree in the open air or in the presence of oxygen, the quality of the filament could be tested by passing electric current through it, the strength of which could be found by experiment. Portions of the filament which have a smaller cross section or an imperfect structure will be heated up to a higher degree than the normal filament and therefore eventually become not only incandescent, but also show a discoloration after the current is turned off.

We also learn that the Nernst lamp seems to be able to utilize the advantages of the metal filament lamp. Mixtures of Tungsten with oxides of Yttrium, Ytterbium and the like can be worked into a filament which is of comparatively high resistance, and therefore short and strong like the Nernst glower; moreover, it is self-starting, like the metal lamps, with which it shares the peculiarity of being enclosed in a vacuum.

Quite a number of new combinations, constructions, and improvements in metal filament lamps are described in the article, and also in a similar compilation in *Elektrotechnik und Maschinenbau,* April 19, among which the manufacture of Thorium filaments by the Siemens Company is worth mentioning. Furthermore, it is interesting to note that the number of patents for lamps utilizing carbides of Boron and Silicon is steadily increasing.

A new and, as stated, altogether "British" metal lamp has been placed upon the English market by the Bryant Trading Syndicate under the title of "Metalite" lamp. Its specific energy consumption is said to be 1, or below 1, watt per candle. It is manufactured for voltages up to 250. Its price varies from 40 cents for twenty volt lamps, up to $1.25 for 250 volt lamps. Accounts of this lamp are given in almost every English periodical.

A rather detailed description of the work done by the glass blower in connection with the manufacture of incandescent lamps appeared in the "Elektrotechnischer Anzeiger." The real object of the paper is a description of the use of metals, and especially base metals, for the "electrodes" of incandescent lamps. The electrodes, or "leading-in wires," as they are more correctly called in this country, must have the same co-efficient of expansion as the glass which they are sealed to and, as the author (Mr. Duschnitz) states by means of a table, only platinum and lead glass meet this requirement. A number of ways are described for getting around the expensive platinum; for instance, by using only a thin film of platinum, electrolytically deposited on an iron wire, or by employing a kind of a putty to form the seal

around the base metal; even copper can be utilized if it is flattened out into a very thin strip of a maximum radiating surface. Some lamp concerns find it advisable to make the glass tube of the stem out of two pieces of different kind of glass. Besides such interesting data quite a number of other tricks and methods employed by the lamp manufacturer are revealed which up to the present time were only known to a small number of the initiated.

### 2. Arc Lamps.

The *Zeitschrift für Beleuchtungswesen* and *Elektrische und Maschinelle Betriebe* give reviews of improvements in the construction of arc lamps and in the manufacture of arc lamp electrodes. Of special interest is a three-phase arc lamp invented by Tito Livio Carbone, which uses three convergent electrodes and several other interesting features for the regulation and maintenance of the arc. Most of the other data given refer to details in the construction of the lamp, and an account of the patents concerned. As a curiosity an arc lamp is worth mentioning the electrodes of which have the shape of a disc.

A new English lamp is the "Jandus Regenerative Flaming arc lamp," invented by A. Denman Jones, which was described in most of English electrical periodicals in the course of February, 1908. A late account of it is given in *Elektrotechnik und Maschinenbau.*

### 3. Gas, Oil and Acetylene Lamps.

In the three April issues of *Zeitschrift für Beleuchtungswesen* the description of the various new inverted gas lamps is continued, showing quite a number of interesting improvements as to the construction of the burners and their suspension. A number of lamps are described using two and more mantles, and the system of the Huer Company is dwelt upon.

In the *Journal für Gasbeleuchtung,* April 4, the report is concluded of the investigation of the conditions affecting the combustion of the gas and air mixture in incandescent gas lamps. The influence of different amounts of air upon the light intensity is determined experimentally by two methods, a chemical and a physical one, and the results are demonstrated by tables and diagrams.

## B. ILLUMINATION.

### 1. History.

The second chapter of a history of illumination is published in the *Journal für Gasbeleuchtung* April 18. It treats of the middle ages, and gives a very interesting and well illustrated description of the fixtures used at that time, mostly for candle and oil lighting. A short discussion is also devoted to street lighting and to light houses, which latter use burning wood as an illuminant.

### 2. Photometry.

Mr. A. Granjon discusses in a short article published in the *Revue des Eclairages,* April 15, the confusion which may arise from the use of different units for the light intensity in different countries. He states that lamps of foreign make, for instance, the Tantalum lamp, could be rated as consuming either 1.96 or 2 or even 2.15 watts per candle, according to the standard used, whether English candle, French bougie, or the German Hefner. This is not only confusing, but may also inflict pecuniary damage.

### 3. Show Window Lighting.

The "Augur" competition for show window lighting, in Berlin, offered a good opportunity for getting a clear idea of the merits of the different methods of show window lighting, and gave rise to discussions and descriptions which are continued in the April periodicals. The publications of the B. E. W. (Berlin Electric Light & Power Company) bring a number of illustrations showing the properties of Nernst and arc lamps for show window lighting.

The *Journal für Gasbeleuchtung* describes the exhibition of the so-called Pharos Light Company. The Pharos lamp is an inverted incandescent gas lamp of 2000 candles and was used to illuminate the windows in two different ways: firstly, by inside, secondly, by outside illumination. The inside illumination was concealed, the outside illumination, as stated, fulfilled the requirements of show window lighting in a particularly excellent manner. The requirements of show window lighting are enumerated as follows:

Firstly, the merchandises shall not suffer from the illumination.

Secondly, the merchandises shall be il-

luminated so that the on-looker is able to clearly distinguish each exhibit.

Thirdly, the illumination shall not produce heat inside the window.

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"Fortschritte auf dem Gebiete der Elektrotechnik." (*Elektrot. & Masch.*, April 19.) Progress in the manufacture of incandescent lamps and their filaments.

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"Die Bestrebung sur Herstellung von Glühlampen Elektroden aus unedlen Metallin oder derem Legierungen," by Berth. Duschnitz. (*Elek. Anz.*, April 12, 16, 19.) The work of the glass blower in the manufacture of incandescent lamps and especially the sealing and material of the leading-in wires.

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"A New Metallic Filament Lamp." (*Electricity*, London, April 24.) Trade publication. Illustrated.

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"The 'Beck' Flame Arc Lamp." (*Electricity*, April 24.) Illustrated. Editorial.

"Jandus Regenerative Flammenbogen lampen." (*Electrot. rundschau*, April 23.) Illustrated report.

3. *Vapor Lamps.*

"Die Quartz Lampe." (*El. & Masch. Betriebe*, April 5.) Illustrated. Description by Alois Ensbrunner.

"La lámpara de cuarzo en substitución de la lámpara de arco." (*La Energía eléctrica*, Madrid, April 25.) Illustrated translation of a lecture by E. Lindeholz on the "Quartz lamp."

4. *Gas, Oil and Acetylene Lamps.*

"Studiem über Verbrennungsvorgänge bei Gasglüh-lichtlampen." (*Journ. f. Gas*, April 4.) Illustrated. Report on experiments made by Dr. H. Bunte, Dr. M. Mayer and Dipl. Ing. Teichel.

"Nene Invertbrenner." (*Zeit. f. Bel.*, April 10, 20, 30.) Illustrated. Description of various types of inverted gas lamps.

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B. Illumination.

1. *History.*

"Zur Geschichte des Beleuchtungswesen," by W. Niemann and Dipt. Ing. Dr. Bois. (*Journ. f. Gas*, April 18.) History of the illumination in the Middle Age.

2. *Photometry.*

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3. *Illuminating Engineering.*

"Bemessung der Stärke der Lichtguellen für indirekte Beleuchtung mit Gaslichlicht." (*Journ. f. Gas*, April 18.) Communication from Schilling regarding the calculation of the candles required for indirect incandescent gas lighting.

4 *Train Lighting.*

"The Leitner System." (*El. Times*, London, April 23.) Illustrated. Description of the system and its advantages.

5. *Show Window Lighting.*

"Ueber Schaufensterbeleuchtung. (*Journ. f. Gas*, April 11.) Illustrated. Trade publication of the Pharos Light Co. on

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"Der Wettbewerb der Schaufensterbeleuchtung." (*Mitt d B. E. E.*, April.) Illustration of show window lighting.

6. *Sign Lighting.*

"Ein neuer Illuminations körper." (*Mitt. d B. E. W.*, April.) Illustrated. New compound for sign structure.

7. *Lighting Hygienics.*

"Gas and Electric Lighting Hygienics." (*El. Industries,* April 15.) A comment on Dr. Rideal's paper by R. B. Matthews.

## Book Review

By Isidor Ladoff.

Das electrische Bogenleight: Seine Entwickelung und seine physicalischen Gundlagen. Von Walter Biegon Von Czudnochowsky Mit 332 Abbildungen im Text und 29 Tafelhr. 698 S in Leox —8 Verlag von S. Hinzel, Leipzig, 1906, Preis geb. 29 M.

This rather unusually long title is characteristic of the book itself. The author obviously set himself the task of creating an exhaustive treatise of the entire field of arc light illumination, an encyclopedia of the Voltaic arc as a source of light. He fulfilled this task admirably in the monograph to be reviewed by us. Especially praiseworthy is the treatment of the proper theme of the book—the arc lamp itself. The history of the Voltaic arc contains a veritable treasury of interesting facts, data concerning early installation of arc light plants and details of the most modern constructions. The historical information contained in the book is particularly valuable for the illuminating engineer in view of the fact, that due to ignorance of the past of the art, many old and tried out ideas are revived again and again as discoveries and inventions. We may, for instance, point out here the scheme of building lamps without regulative mechanism claimed over and over again by alleged inventors. Likewise we may call attention to the numberless attempts to patent metallic tubes as containers of arcing material, also the patenting of carbides in the United States, after they were monopolized long ago in foreign countries, etc., etc. The theoretical part of the treatise is rather unharmonious with the rest of the subjects, in view of the fact that its readers are supposed to be people with sufficient training in the rudiments of Physics. We doubt the wisdom of devoting so much space, as the author did, to the exposition of the theory of heat and the elements of the theory of electrons, the latter being freely compiled from Lummers' "Ziele der Leuchtechnik." At the same time the author hardly devoted enough attention to the fundamental principles of the theory of illumination, of the interdependence between Light-radiation and illumination, principles without which the illuminating engineer is helpless, especially when a choice between various systems of lamps is to be made. We likewise question the advisability of treating the entire field of the arc light illumination from the historical viewpoint, especially when each step forward is being described with minutest detail and analyzed philosophically. Many subjects are repeated and mostly scattered all over the book in fragments. The general reviews at the end of each separate section of the monograph also add to the weariness of the exposition. These defects will be especially exasperating for the American reader in view of the absence of a comprehensive systematic index of subjects treated at the end of the book. We call the attention of the reader to many excellent chapters in the book; for instance, to the chapter devoted to the theoretical and practical treatment of the search light, the mercury arc and others. The treatment of the enclosed arc is rather narrow and one-sided, especially his view on the relation between life and efficiency of such lamps. Wedding proved in his work, "Ueber Bogenlampen mit eingesschlossenem Licht-bogen," that there is hardly any pronounced connection between the degree of the exclusion of the air from the inner globe and luminous intensity of the enclosed arc. On the whole the book produces the impression of embarrassment of riches. It is written in an attractive style. The illustrations are well executed and the general make-up of the book is beyond criticism. The volume will be a valuable addition to the library of every illuminating engineer.

# Miscellaneous News

BALTIMORE, MD.—One of the largest contracts in the history of local lighting has been awarded to the Consolidated Gas, Electric Light and Power Company by the United Amusement Company, which will operate Electric Park. The contracts call for current for 40,000 electric lights, of which about 25,000 are to be immediately installed and the balance later in the season. The current will be supplied from the Westport power house of the Consolidated. At Electric Park a transformer station will be built which will be the largest in the city.

It is planned to make Electric Park live up to its name. Mr. J. D. Buckley, who was prominently connected with the illumination of most of the large expositions, including Jamestown, is already on the ground and is planning the illumination effects. It is proposed to make the park a picture in light. The buildings will stand out in bold outline, while towers and minarets will be lavishly decorated in light. The lamps will be from 50 c.p. down to 4, so the effect should be a magnificent one. A "dimmer" will probably be used, by means of which the lights will grow into life gradually. At first there will be faint glow, which will become brighter and brighter, until the entire 40,000 lights will be burning.

In order to appreciate the magnitude of the contract it may be said that the lights within the area of Electric Park will be more than twicc the unmber used during the Home-coming celebration, and if placed 2 feet apart would reach from the American Building to Annapolis.

HAGERSTOWN, MD.—According to the annual report submitted by Superintendent J O. Beard, of the municipal electric light plant, to the Board of Street Commissioners, the streets of Hagerstown are now being lighted every night in the year, and all night, by 144 arc lights at a cost of $14.12 per light. Current for commercial light and power purposes is sold from the city plant, and it is this source of revenue that makes the street lighting so cheap.

One of the secrets of the success of the Hagerstown plant is the fact that its management is kept out of politics. The plant is under the supervision of the Board of Street Commissioners, an appointive body, with minority representation, which serves without pay. The change politically in the administration of the city is not permitted to affect either the management or employees of the city light plant.

MIDDLETOWN, CT.—The directors of the Middletown Electric Light Company have voted to purchase a plot of ground at the foot of College street, which has been used as a public playground. It is the intention of the company to erect a modern plant on the property at once. They expect to be able to furnish electricity at a much lower rate than at present.

PARK RIDGE, N. J.—Park Ridge, Bergen county, has gone crazy over a municipal lighting project. Never before in the history of a Bergen county town or village has such a condition of affairs existed.

Some time ago the authorities of Park Ridge voted an appropriation of $30,000 to buy property and build and equip the plant. Right on the jump property values went skyward, and this was especially so with the tract selected. Another $30,000 was voted for the project.

The action of the borough authorities was brought to the attention of Judge Charles W. Parker, and the court laid the matter before the Bergen county grand jury, of which ex-Mayor Robert Sibbeld, of Park Ridge, is a member. This circumstance has increased the excitement at Park Ridge until it is now at fever heat.

Two new weekly papers have sprung up to represent both sides of the lighting question, and peppery articles are published in each issue.

In the meantime, right in the face of the stern remarks of the judge, another appropriation of $30,000 has been voted by the council, making $90,000 in all.

The

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# *Light Lengthens Life*

We live in deeds, not years ; in thoughts, not breath ;
In feelings, not in figures on the dial.
* * * * He most lives
Who thinks most, feels noblest, acts the best.
—*P. J. Bailey.*

---

*Modern illumination has done more to open those inexhaustible storehouses of knowledge—books—to the workers, the masses, than any other single agency except the printing press.*

*Consider this fact: Knowledge, so far as it may be obtained by reading, never became general until the introduction of illuminants; and it has spread and increased just to the extent to which artificial illumination has advanced. The relation of light to knowledge and civilization—to* ENLIGHTENMENT*—is far more than a mere figure of speech. As an actual physical entity, light is the necessary complement of knowledge, and the primary source of enlightenment.*

*The time from sunrise to sunset no longer limits the hours in which man may work and play. His hours for recreation, and for mental pursuits and improvement, have been multiplied tenfold by the practical annihilation of night.*

*We like to read of Lincoln studying his law books on the hearth, by the light of the blazing logs in the fire-place; but if* YOU *had no other opportunity of acquiring knowledge from books, what would be the extent of your learning to-day?*

*If you would know to what extent artificial illumination contributes to your enjoyment of life and the accomplishment of those purposes which make life worth living, try doing without it, even for a single day, or go back to the poor little flickering, light-sources of a century ago.*

E. L. Elliott.

# The Modern Searchlight

By A. H. Keleher.

We are all vitally interested in the searchlight and its wonderful performance, because its use has become universal at the present time. The searchlight, or projector, as it is technically called, is used for "picking up" an enemy's ship at night, and for signalling in the Army and Navy, and for target practice as well; for stereoptican illumination, theater illumination, scenic effects, electric headlights for locomotives, advertising, and for other purposes too numerous to mention.

A searchlight consists essentially of a focusing lamp mounted in a cylindrical box provided with a reflector and mechanical accessories for sending the beams so obtained in the required direction. The lamp, which we must consider here, consists of the arc light with which we are so familiar in connection with the lighting of our streets. As this plays so important a part in the functioning of a searchlight, it is of interest to trace the development of the carbon arc from its conception or discovery.

In the year 1800 Volta discovered the electric spark, and contemporaneously, Sir Humphrey Davy discovered bright sparks between carbon points operated either in air or under liquids. In 1808, eight years later, Davy announced the first carbon arc. Since then there has been a gradual development until we have the powerful arc used in the modern searchlights of to-day and the intense flaming arc which has of late come into use. When electricity is made to pass through two pieces of carbon separated from each other by a slight distance, the carbons become heated and the tips of the carbons facing each other become heated to white heat. Part of the carbon vaporizes, and it is this vaporized carbon which forms the arc proper. However, but a small proportion of the total light emitted by the light source emanates directly from this arc. In round numbers, 85 per cent. comes from the crater of the arc, which is the glowing tip of that particular carbon where the electricity enters the lamp; 5 per cent. from the arc proper, and 10 per cent. from that carbon by way of which the electric energy leaves. Formerly, carbons made of coke or charcoal were used exclusively, but it is found that

for some purposes, if carbons are used which have been cored and filled in with some softer combustible material, a more powerful and steady light will result. These cored carbons are used in searchlights; the positive carbon (the one which affords entrance to the electricity) is made a little larger in diameter than the negative or exit carbon, because it is found that it is consumed about twice as rapidly as is its neighbor. Generally speaking, the life of the carbon is longer as its diameter grows bigger, and so by making the positive carbon the larger of the two, the lives of the two become equal. A good pair of carbons will average a life of six hours. As has been said, the passage of the electric current from one carbon to the other causes the carbons to heat up until the carbon vaporizes. The carbon in this condition gives off a very intense heat, its temperature rising to 3500 degrees Centigrade. Now as the efficiency of a light-source is greater, the higher the temperature, it is to be expected that the arc is the most efficient light-source known. Such is found to be the case, and of the electrical energy required to operate the arc about 13 per cent. is converted into useful light rays.

The purpose of the parabolic mirror, used in connection with the searchlight is to gather up the light rays coming from the carbon arc and redirect them in the required direction. The word "parabolic" indicates the shape of the mirror. By placing a light source in the focus of a parabolic mirror, reflected rays are thrown off, and all of these rays are theoretically parallel to each other. This is not the case in actual practice, however, as, owing to dispersion due to the size of the source, atmospheric absorption and other causes, the beams are not truly parallel.

The small colored glass windows shown in the photograph of the searchlight are provided to correct for the wandering of the arc from the focal position. It is, of course, important to keep the arc at the focus of the mirror, because if this is not done, the emerging light rays will not be parallel, and consequently the projector will not have the maximum possible range, which in the case of good lights varies from 4000 to 10,000 yards.

When large searchlights with mirrors having great diameters are used, it becomes necessary to use some form of power to operate the turning gear of the searchlight. For this purpose there are used a vertical wheel and chain operated by an electric motor, which turns the barrel of the searchlight around its horizontal axis, and a motor-driven, revolving base, which allows the light to be turned from one point of the compass to another. These motors are capable of different speeds, so that the light may be used in different classes of work. For instance, a searchlight intended for use on a warship, or in a fort, must have a very versatile turning gear, while a searchlight used on shore for minor purposes, need only be worked by hand, as the light is directed on the target and allowed to stay.

From the picture it will be noted that the glass door of the projector barrel is composed of strips of plate glass. This window is included to protect the searchlight mechanism from the wind and rain, and is made of strips so that it will not crack from the effects of heat. A broken strip can be easily removed and a new one inserted in its place. These flat strips are at times replaced by lens strips, the surfaces of which are rounded in order to make the light rays diverge, which condition is sometimes desired. This divergence of the rays could also be secured by removing the arc slightly from the focus of the mirror.

Some remarkable claims have been made as to the range of various searchlights, one authority going so far as to state that objects could be seen at a distance of a hundred miles when the weather conditions were just right. This statement must be taken with the proverbial grain of salt, but great distances have been reached by using powerful projectors. The record seems to be held by the Navy. On one occasion when the *Newark* and the *Charleston* were lying in the River Platte, in the vicinity of Montevideo, Uruguay, under exceptionally good conditions of the weather and clouds, signals were exchanged between the two vessels when they were lying sixty-five miles apart. A good searchlight will have a range of three miles, that is to say, an object three miles away from the light will be brilliantly and distinctly illuminated. Not long ago a test was made at the Brooklyn Navy Yard of one of their powerful lights intended for use on shipboard. The shaft of light was turned in

the direction of the Times Building, approximately three miles distant, and while the observers in the tower at Brooklyn could not see any one on the roof of the Times Building, a man stationed there, looking at the searchlight was dazzled by its brilliancy. At one time the light was turned on a point about the same distance from the tower but in the direction of Flatbush, with similar results. The night was foggy, and although one of the natives of Flatbush was blinded by the light, he could not be seen from the tower. A 30-in. projector on the summit of Mount Washington is used to show to the tourists stopping there the beauties of the surrounding mountains. When turned on the Lizzie Bourne monument, 1200 ft. away, the monument looms up sharply from the background.

On board of a large war vessel, the captain is spoken of as the "brains," the engine room as the "heart," and the searchlight as the "eye" of the ship. The writer, on one occasion, during the Spanish war, in the Philippines, had occasion to come under this powerful eye and note its startling effects. A party had been ashore to visit the military and naval camps at Cavite, and were returning to the transport *Indiana* in a gig manned by Filipinos and belonging to one of the captured Spanish gunboats which had been turned over to our brown brothers by Admiral Dewey. The United States monitor *Monadnock* was lying at anchor in the bay off Cavite at that time. We approached very close to the monitor, and upon failing to answer the challenge from the naval vessel, the searchlight was suddenly turned on us, and we were informed by one of the officers that our negligence in not answering might have cost us dearly, as he had had half a mind to turn the contents of a six-pounder loose in our direction.

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GENERATOR AND GASOLINE ENGINE MOUNTED ON TRUCK.

SEARCHLIGHT MOUNTED ON TRUCK FOR MILITARY USE.

out on the same principle, only the flashes are secured by moving a screen across the window of the barrel. The "wig-wag" system is also largely in use in the Army. In this branch of the service, however, wig-wagging is generally done by means of flags.

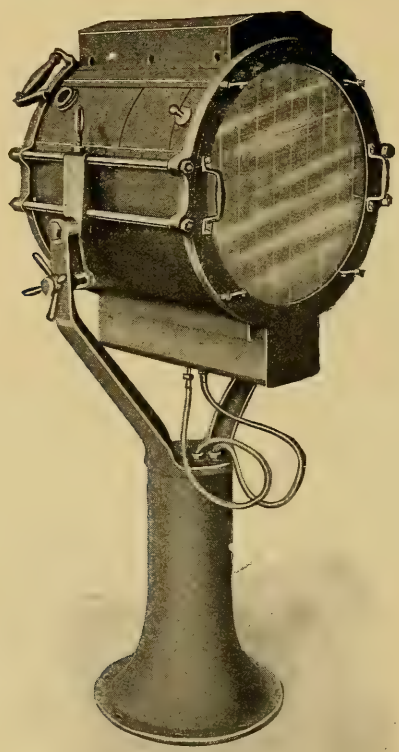
Uncle Sam's ships are, in the main, equipped with 30-in. projectors. Some of the vessels, notably the *Massachusetts*, are equipped with 36-in. projectors. There are a few 60-in. searchlights in use, but they have proved unsatisfactory, and are considered out of date. The *New Hampshire* is equipped with two 60-in. projectors, and the *Connecticut* with one.

Each ship is now equipped with portable searchlights which are at all times available for use in connection with landing parties. It is expected that, in the future, these outfits will be of valuable use to such parties. They have never been given an actual trial in warfare, as they have only come into use since the Spanish War. Each of these portable lights consists of two parts. On one carriage is mounted the generating apparatus, and on the other is the projector and a drum on which is wound some insulated wires. These wires transmit the electricity from the generator. Gasoline is the fuel which operates a little gasoline engine. The horsepower of these engines is about six.

Portable searchlights are used to some extent by the Signal and Artillery Corps of the Army.

Some idea of the size of the large projectors may be obtained by considering some of the data on a 60-in. projector. One weighs 6000 pounds, and requires for its operation about thirteen and one-third horsepower. Both of the carbons are cored. The upper carbon is 1½ in. in diameter; the lower, 1¼ in. The lighting power is about 1,200,000 c.p.

Before a searchlight is accepted, it is tested for its range by comparing the light given off against that emitted by a standard Schuckert projector. A test is also made on the mirror to see that it is truly parabolic. If the results of these two tests are satisfactory, the light is accepted.




# How They Do It Out West

Everett is a city of 20,000 inhabitants, situated in the State of Washington, and is one of the towns that believes in "lighting up and keeping lighted up."

Mr. John A. Juleen, writing from this city, says: "The enclosed photograph shows how the main street of our city looks at night. We have about sixty-five electric signs, and the spectacular lighting, reduced to 2 c.p. lamp equivalents, would amount to about one lamp for every two inhabitants of the city. This special lighting is permanent, and the business men along the street pay for the installation and the cost of maintenance."

Expressing Mr. Juleen's figures in a somewhat different manner, the spectacular lighting amounts to a candle power per inhabitant. Where is the town that can beat this record? And this is all paid for by the business interests located along the streets that are specially illuminated. Undoubtedly Everett citizens are proud of their town, but is it likely that the maintenance of this proportionately elaborate spectacular lighting is paid for simply as a matter of civic pride? Is it not altogether probable that the business men have found it a sound business proposition to "light up and keep lighted up"?

There is a story that tells how, once upon a time, the mistress of a tenement apartment was presented with a potted plant in full bloom. In order to give the plant a fair chance the lower half of the window was washed, which was really an event in this household. The sunlight, shining brightly through the clean portion, made the upper half look so dirty that the washing was extended. The flood of light thus admitted brought out so conspicuously the dust and grime that had accumulated everywhere that a general cleaning up resulted; and to come to the point of the story at once, the cleaning up of the window resulted in the complete regeneration of the whole household, first physically and then morally, so that they lived happily ever after.

The contract agent of the central station in a small, out-of-the-way town tells a story of how the lighting up of a single store on a gloomy street led to other similar installations, until the whole street was converted into a brilliant thoroughfare.

It is not necessary to wait for concerted action in order to start the "bigger and brighter city"; a single example is often all that is necessary.

"THE FAUST" RESTAURANT, COLUMBUS CIRCLE, NEW YORK.

# Novel Restaurant Lighting

By H. Thurston Owens.

That the restaurants of New York lead those of both Paris and London in the matter of elaborate and attractive decorations has been a fact quite generally conceded. The recent additions to the already long list have exceeded their predecessors in these features and the illumination is fast becoming *the* feature instead of only one of them.

An example of the progress made is illustrated by the café and the restaurant of the Hotel Algonquin, West Forty-fourth Street, between Fifth and Sixth Avenues, New York City. The former room is shown in Fig. 1, and it contains all of the inducements to good fellowship and conviviality. The walls and ceiling are a dull terra cotta with white woodwork, the only lighting fixtures being the ceiling lamps in the individual plaster holders shown.

The restaurant, shown in Fig. 2, which is designed to represent a garden, is comparatively small, although by the clever arrangement of mirrors the first impression is of a room twice its size. Mural paintings of outdoor scenes on one wall are reproduced by the mirrors so that the garden, or outdoor effect, has been quite successfully carried out. The woodwork consists of columns supporting an arched lattice, all in white. In the roof of this arbor oak leaves and wistaria blossoms are entwined, and the red and yellow mosaic glass lighting fixtures are in the form of acorns.

The room only contains three rows of tables; those in the center have pendants with red cloth, beaded fringe shades, and those along the wall portables, each different and each attractive. The designer is a past master of the art of producing pleasing effects, however much they offend the ultra artistic, and he has not been satisfied as many might with the array of lamps

FIG. I.—ILLUMINATION BY LAMPS STUDDED ON THE CEILING IN PLASTER ROSETTES.

FIG. 2.—ILLUMINATION BY LAMPS IN ACORN-SHAPED GLOBES OF LEADED GLASS.

described. There are two handsome standards with enclosing globes of mosaic glass, reflector lamps to light the paintings, and incandescents in paper shades at what appears to be an entrance on the side of the room.

Columbus Circle is at the southwestern end of Central Park, and The Plaza is at the southeastern end; the former is the intersection of Broadway, but over a mile north of that portion known as the Great White Way. A café and restaurant, known as "The Faust," has recently been opened here, and its success has largely been due to the illumination. The entrance is through a rustic bower with red tinted incandescents suspended from the roof. The restaurant, shown on page 198, is not large, but very inviting; the woodwork is dark green, with mirrors and tapestries, the ceiling arranged as a bower with leaves.

There are three types of fixtures in use —chandeliers, brackets, and ceiling lamps; the first two are combination fixtures with imitation candles for gas and incandescents in pendant green art glass shades and beaded fringe. The ceiling lamps are purely ornamental, being bunches of grapes, made of glass, enclosing incandescent bulbs, and tinted both red and green. The installation is in every sense a successful one, and it has many points worthy of consideration.

## An Effective Show Window

THE TUNGSTEN LAMPS UNDER THE CANOPY SERVE TO ATTRACT ATTENTION AS WELL AS TO ILLUMINATE THE GOODS WITHIN; AND BEING ABOVE THE WINDOW DO NOT INTERFERE WITH VISION.


# Commercialism in Fixture Design

By E. L. Elliott.

We have occasionally charged the fixture manufacturer with subjugating art to commercialism in the designing of his wares, and have furthermore sometimes differed with the designer as to the general principles of decorative art as applied to fixture manufacture. These expressions are the simple exercise of the prerogative of every man to hold his own opinions and express them as occasion may offer.

In a paper presented before the Philadelphia section of the Illuminating Society, Mr. F. C. Dickey takes up the discussion from the manufacturer's point of view, and presents his arguments in a particularly clear, dispassionate and persuasive manner. The discussion of this particular case is but a corollary to a very much broader proposition, namely, commercialism versus idealism in business. In many cases commercial men have no ideals, except, of course, the dollars-and-cents results, and consequently are not at all concerned with this discussion. On the other hand there are a considerable number of cases in which idealism to a certain extent is an essential element of the business. This holds in all branches of manufacture which have to deal in any way with art in its larger sense. The manufacturers of lighting fixtures, and of books and periodicals, fall in this category.

Mr. Dickey says with regard to fixture manufacturers:

"While they may be regarded to some extent as teachers of their clients, and do endeavor to instill more esthetic ideas in their taste, none is so situated financially as to be able to take a rock-like stand and offer himself as a willing sacrifice for the sake of the ideal, which, in the majority of cases, would be brushed aside for the more tawdry or showy objects anyhow. No manufacturer is in a position at the present time to confine himself entirely to purely ideal fixtures and produce enough to return a satisfactory profit. Whether willingly or not, he is compelled to turn out more showy, even if less artistic pieces, which please the eye of the greatest number."

We are not prepared to dispute the truth of Mr. Dickey's statement *in toto*. The education of the people in any direction, and particularly along artistic lines, is a slow and expensive process. For a fixture manufacturer to insist upon supplying only such designs as he considered in accordance with the canons of true art would probably result in financial ruin. There is, however, in this, as in all other similar cases, an opportunity to constantly work toward better things; and such a policy is not only productive of the general satisfaction that always arises from keeping apace with progress, but will bear financial fruits in due season.

Humanity might be divided into leaders and followers. It is always a profitable policy to cater to the leaders. The way to catch a flock of sheep is to first catch the bellwether: and as Carlisle and various other writers have observed, humanity is very much like a flock of sheep.

On finding that there is a greater or less failure on the part of people to appreciate

what one considers good, it is quite natural for one to suffer a reaction and swing too far in the opposite direction. After all is said and done, there is very considerable appreciation of, and in fact a seeking after, what is good, or what is better than that in common use. Undoubtedly the charge that the people are unappreciative of good art arises more from a failure to produce what is intrinsically good than to the lack of appreciation of it. It is easy to keep on producing what people have once gotten into the habit of calling for; and so long as the people see nothing better, they will take what is offered, and generally without serious complaint.

We are still of the opinion that in fixture designing, as in all other cases of commercial art, originality and essentially good art would find a degree of appreciation which would make it commercially profitable. Before condemning the people too strongly for lack of appreciation, let us be quite sure that we are offering what they can accept without doing violence to such judgment and taste as they possess.

In the manufacture of articles which are only one degree removed from raw material, such as pig iron, for instance, the elements of cost are almost wholly confined to the cost of materials and of the routine, or mechanical labor expended; the original, or creative labor is an inconsiderable factor, being represented only by the inventive ingenuity represented in the apparatus used in the production. In the case of pure art, such as painting and sculpture, the other limit is reached, in which the routine labor is comparatively *nil*, the cost of raw material insignificant, and the creative, or original labor the only essential element of value. Between these two limits lies the whole broad field of manufactures.

The manufacture of lighting fixtures is nearer the artistic than the materialistic limit; at least, it is theoretically so. The fixture manufacturer is an artisan, that is, one who applies art to objects that are primarily utilitarian; in short, he is an art-metal manufacturer.

What we are contending for is simply more art and less metal.

We should like to see the creative, or artistic element play a larger part, and in consequence, see prices based more upon artistic than mechanical results.

Probably there is no fixture manufacturer who would not sooner derive his profits from original and creative labor than from the purely mechanical and routine work. The former requires a much smaller investment of capital; the handling of a smaller number of accounts; a higher general quality in production; and contact with a more generally intelligent class of clients. But to accomplish results along these lines the people must be taught, if they do not already understand, that the value of any piece of applied art is dependent upon the artistic excellence and originality displayed, and not upon the amount of alleged ornamentation or material used. In looking over the fixtures in a manufacturer's exhibit sometime ago, we were shown a particular piece which was pointed to with no little pride by the maker for the reason that it had been awarded a prize at an international exposition; and in pointing it out he laid particular stress upon the number of pounds it weighed—something over a ton, as we recall. Presumably the fixtures which were *not* awarded prizes weighed less.

To accomplish results in this direction requires two things—first, that really good art be used; and second, that the most artistic designs be shown to clients first, and their real merits properly and carefully explained, if necessary. Applied art, to a certain extent at least, is a matter of taste; and naturally no single "school," nor the fads of any individual designer, can be offered with the expectation of their being accepted by all clients.

There is undoubtedly an increasing number of Americans who would prefer individuality and exclusiveness in the design of a fixture to any amount of elaboration, even though it were not really bad art, that was turned out "in bulk." Such clients are both willing and able to pay well for designs which really please them, which are not as common as the chromos given with the Sunday newspapers.

A case in point was related to us recently: The owner of a residence in a certain city had looked over the fixtures of a number of manufacturers, and had secured advice from the electrician and others. In every case it had been assumed that price was the one thing of paramount importance. Not being satisfied with any of the designs submitted, however, an independent designer from another city was

the direction of the Times Building, approximately three miles distant, and while the observers in the tower at Brooklyn could not see any one on the roof of the Times Building, a man stationed there, looking at the searchlight was dazzled by its brilliancy. At one time the light was turned on a point about the same distance from the tower but in the direction of Flatbush, with s'milar results. The night was foggy, and although one of the natives of Flatbush was blinded by the light, he could not be seen from the tower. A 30-in. projector on the summit of Mount Washington is used to show to the tourists stopping there the beauties of the surrounding mountains. When turned on the Lizzie Bourne monument, 1200 ft. away, the monument looms up sharply from the background.

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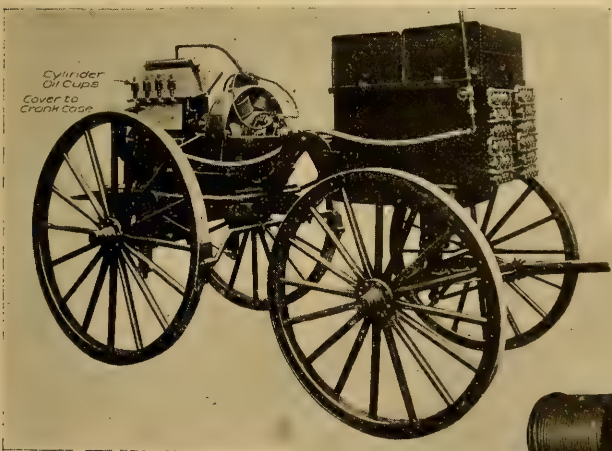
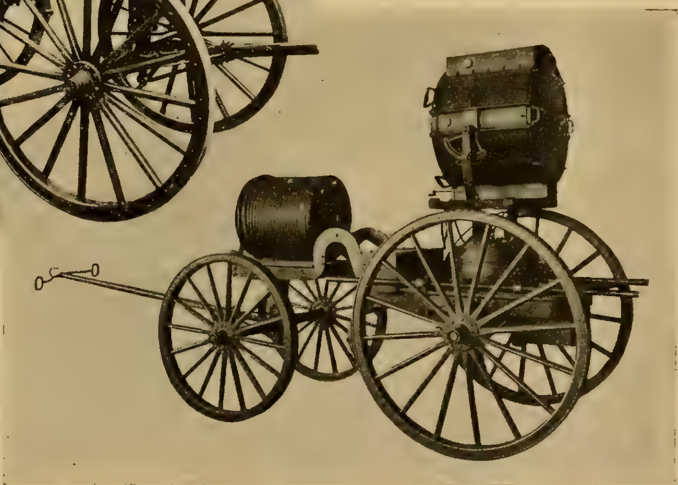



GENERATOR AND GASOLINE ENGINE MOUNTED ON TRUCK.



SEARCHLIGHT MOUNTED ON TRUCK FOR MILITARY USE.

# One-Light Chandeliers

The terminology of illuminating engineering is in need of a few new terms. For example, the word chandelier has entirely ceased to have its original meaning, that is, a candle holder, and is used loosely to cover a large variety of lighting apparatus—so large a variety, indeed, that it ceases to have the definiteness which should attach to engineering or semi-scientific terms. But, for want of a better, or more befitting term, we must use the word chandelier in our present discussion, meaning thereby a device by which a light-source with its accessories may be suspended from the ceiling.

The chandelier, in its original form as a candle holder, always provided for the support of a considerable number of candles, which was a necessary result of the small illuminating power of the individual candle; but with the introduction of the powerful mantle gas burner and electric lamp, the single light chandelier has become a frequently used and important member of the lighting fixture family.

From the purely utilitarian or illuminating engineering standpoint, the one-light fixture is the simplest of all problems to solve. A single electric lamp or gas burner, provided with a form of reflector that will give the desired distribution, is extremely easy to design; in fact, such combinations are regularly sold at the present time under the name of "units"—a term which bears evidence of their simplicity. When it comes to giving the one-light fixtures artistic treatment, however, the problem becomes one of the most difficult to solve of all the cases of fixture design. "Beauty unadorned" is always acceptable, but the one-light fixture has no inherent beauty, and in many instances is a case of ugliness, adorned—or unadorned.

Fig. 1 shows a number of cases which illustrate this statement. They represent the American idea of disguising what is inherently cheap and awkward. No. 1 hides the purely mechanical necessities of construction by the simple resort to a spirally beaded casing tube over the gas pipe which supports the socket. In No. 2 the use of a similar casing of large diameter, and a bulb in the center of the stem, represent the next step in the evolution of the artistic idea. In No. 3 the spiral twist is omitted and a peculiar kink given to the pendant tube just above the socket. You can fancy the workman saying as he takes the piece of straight tube, "Now you just watch me make this look pretty." In No. 4, the spiral tube is again used and with a hitch taken in it at the bottom so that the lamp will be supported at an angle; but the instability thus produced ren-

1. 2. 3.

FIG. 3.—THE SIMPEST ORNAMENTAL FORM OF GAS FIXTURE.


Fig 1.

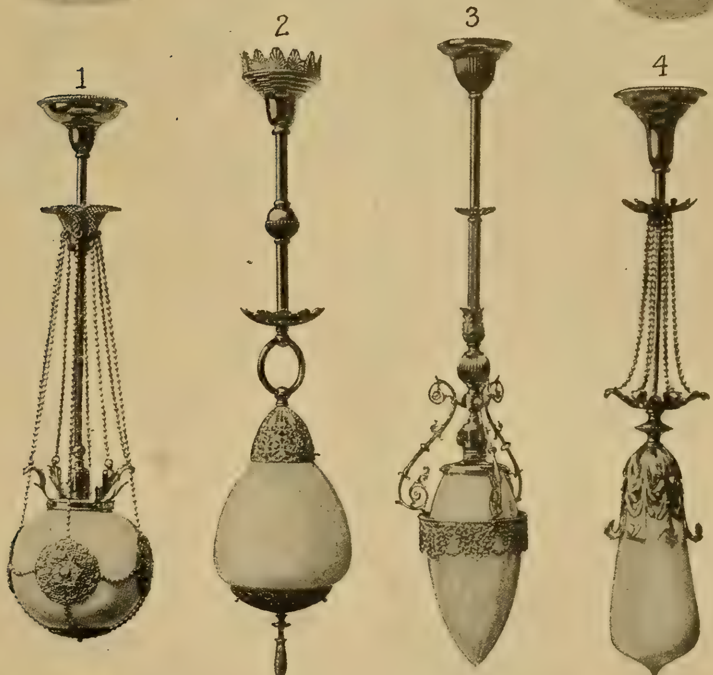



Fig 2.

ders it hopelessly bad, both artistically and mechanically. In Nos. 5, 6, and 7, more evident attempts at decoration are in evidence, none of which will withstand critical analysis. In No. 5 the two curliques are too conspicuously ornamental, and suggestive of the ear-rings of Italian immigrants. In No. 6 the variation of the form of the casing is rather pleasing, but the filigree metal work over the globe is tawdry and worse than useless, forming a mere obstruction to the light. No. 7 is simply meaningless.

Fig. 2 shows some examples of more serious attempts at artistic effects, in all of which, except possibly No. 4, the principles of illuminating engineering and 4 a very general harmony of lines is preserved; the metal work at the top of the globe serves the purpose of holding the globe in place and, provided the lamp is dropped below this, the lighting results should be fairly good.

The most difficulut problem in the one-light electric fixture is to get away from the stiff, mechanical appearance of the supporting tube. Naturally the easiest way around this is not to use a tube at all, but a chain, for supporting the lamp and its accessories. The single objection to this is the necessity of threading the flexible wires through the links of the chain, which interferes more or less with the chain effect.

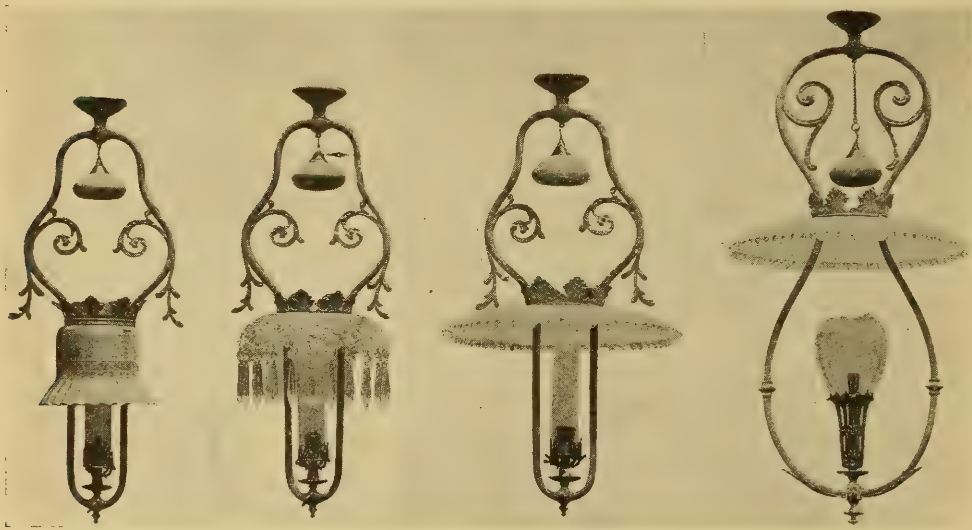


FIG. 4.—VARIOUS TREATMENTS OF FIXTURES FOR UPRIGHT MANTLE BURNERS.

decorative art are both transgressed. In No. 1 the bead work appliqué ornamentation on the globe suggests that the wardrobe of an Oriental dancer has been invaded to furnish decorative material; furthermore, the ornamentation can serve no possible purpose other than to shut off light in the most useful directions. In No. 2 the filigree work and handle on the bottom of the globe are so obviously in the way of the most useful light rays, and so devoid of any possible useful purpose, as to utterly preclude them from artistic consideration. In No. 3 the filigree metal ring around the center of the globe, together with its supports, is similarly obstructive and therefore inartistic. In No.

Another method of surmounting the difficulty is to use a specially designed flexible cord instead of the chain. This cord is made by introducing two flexible steel wires overwound quite heavily, as are also the conduit wires, the outer winding being preferably of silk floss, which has a dull finish. The steel wires are used to support the weight of the lamp and globe, thus conforming to the underwriters' requirements in the case. Artistically, the idea is to give the cord a sufficient appearance of strength to take away the flimsy look of the ordinary flexible wire. The effect is that of a rope rather than of a mere cord, and although it may hang as straight as a tube, it lacks entirely the

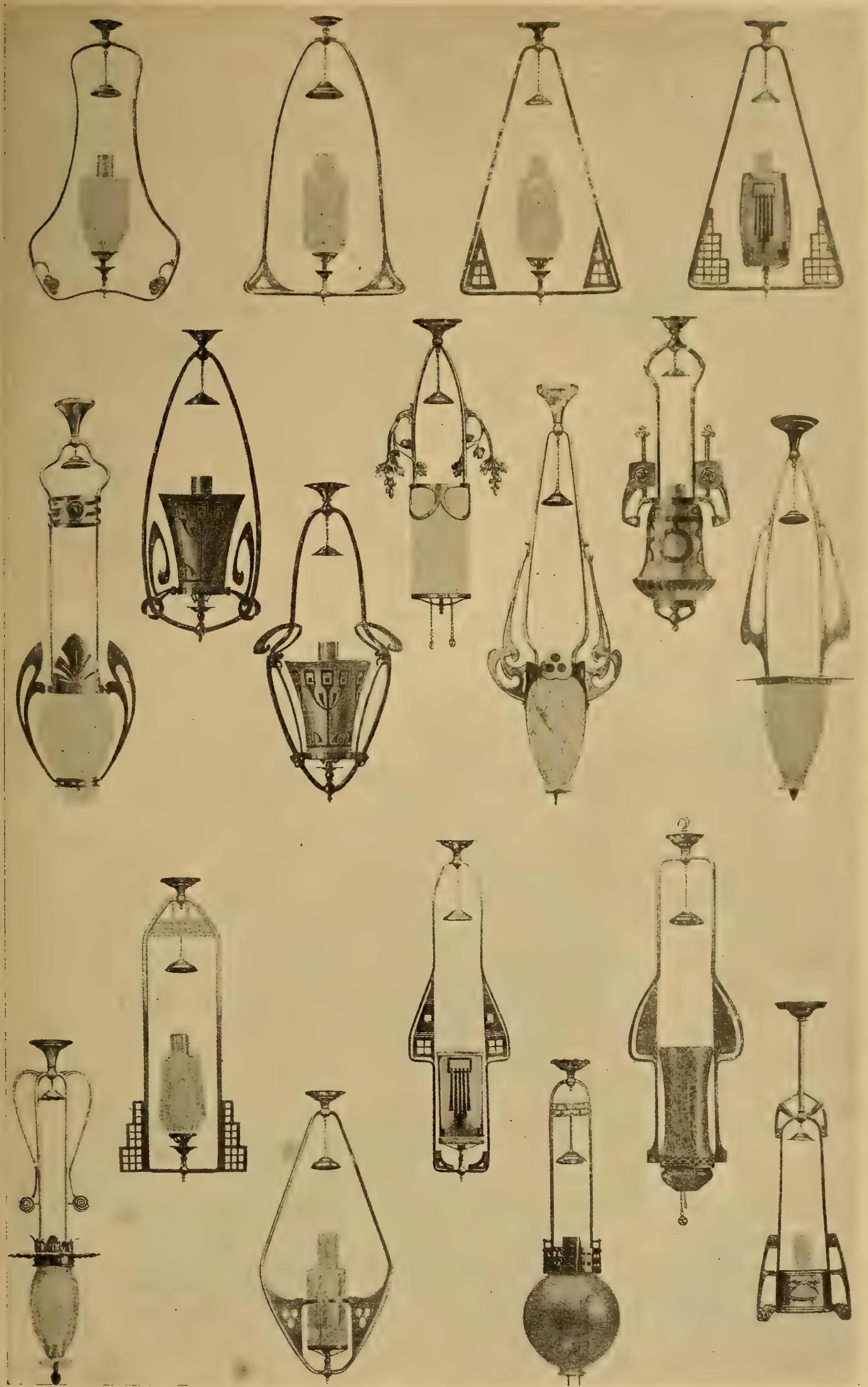


FIG. 5.—UPRIGHT MANTLE BURNER FIXTURES IN ART NOUVEAU DESIGN.

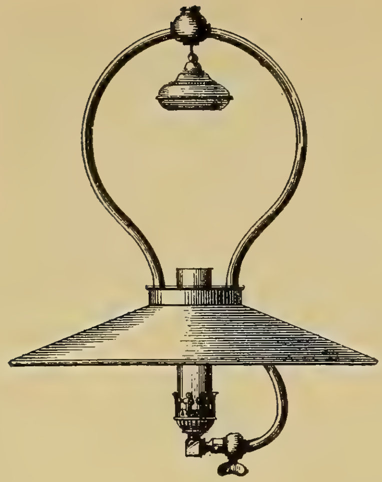


FIG. 6.—UNBALANCED EFFECT DUE TO LACK OF SYMMETRY.

stiffness of the latter, having the flexibility and softness associated with cords.

In general, the attention may be called to the absurd practice, which has existed to a greater extent than would seem possible, in view of its evident absurdity, of putting metal work which has absolutely no real or mechanical use over globes and shades. This is an outrage alike against illuminating engineering and decorative art.

The construction of the one-light gas chandelier for the use of the upright mantle burner so that it shall be both efficient and artistic, presents even more difficulties than does the electric light fixture. In order to keep the supporting parts out of the way of the burner and globe, a double support placed symmetrically on each side of the burner is the usual method resorted to. This forms the familiar "lyre" type of fixture. The enforced symmetry of this construction is almost as difficult to handle artistically as the stiffness of the single support in the case of the electric fixture.

Fig. 3 shows the simplest solution of the problem. No. 1 depends entirely for what little artistic merit it may possess upon the curve of the side tubes and the form of the reflector and smoke-bell used. In Nos. 2 and 3 even the decorative effect of the reflector is absent, but the apparatus is interesting from the fact that it is convertible for either direct or indirect lighting.

Fig. 4 shows a number of variations of the general theme which require no special comment.

Fig. 5 shows a number of modifications of this type of fixture, representing German ideas of the art *nouveau* school. Whatever else may be said of art *nouveau*, it at least has the virtue of originality. It is a distinct departure from all the schools and types of decorative art that have heretofore prevailed, and deserves encouragement for the simple reason that it is not a copy or rehash of previous ideas, if for no other reason. While it is the prevailing "mode" for nearly every kind of decorative art abroad, it has made very little progress among American designers and workmen. While the central idea, or *motif*, of this school of design is unquestionably good, there is no doubt that it offers peculiar temptations to run into freaks and fads. Doubtless some of our readers will be inclined to find evidences of this among the designs shown. Because a thing may be perverted, however, is not a sufficient reason for discarding it altogether; and this school offers as great opportunities for combining originality and true art as it does of producing freaks.

Fig. 6 shows plainly the lack of symmetry and apparent mechanical insufficiency produced by omitting one side of the supporting tube.

While the problem of constructing a one-light gas fixture for an upright burner,

FIG. 7.—BALANCED FIXTURE WITH SINGLE TUBE.

FIG. 8.

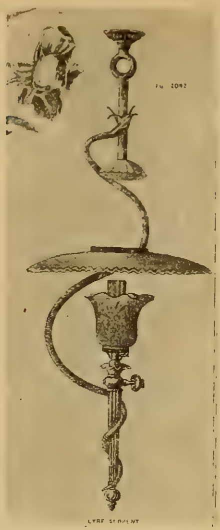


FIG. 9.

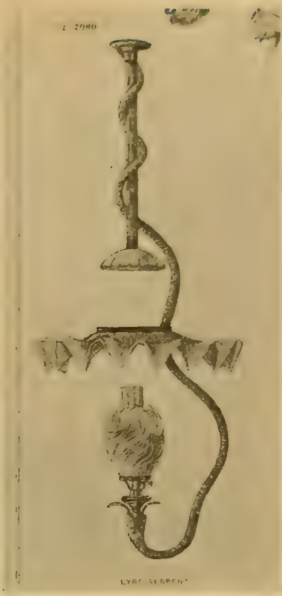


FIG. 10.

SUCCESSFUL SINGLE TUBE FIXTURES.

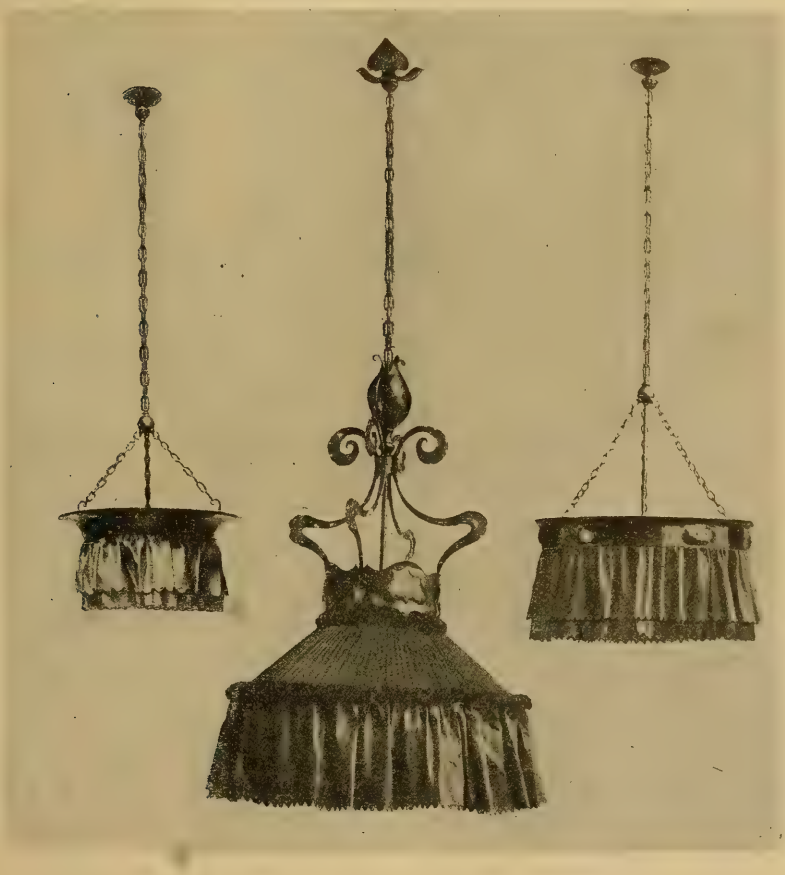


FIG. 14.—GAS FIXTURES WITH CHAIN SUPPORTS.

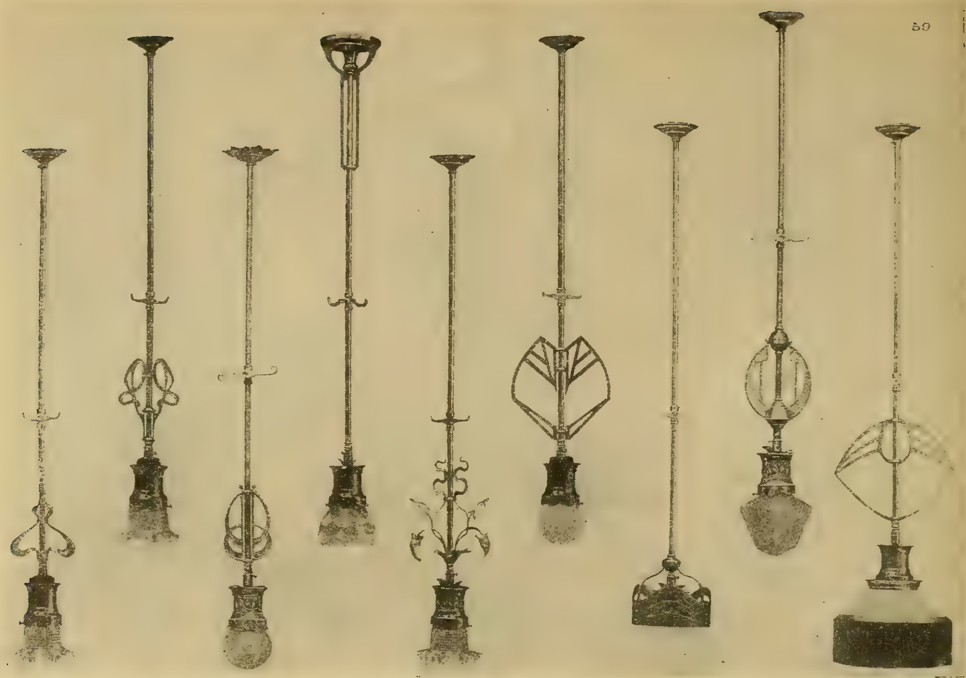


FIG. 12.—SIMPLE FIXTURES FOR SINGLE INVERTED BURNER.

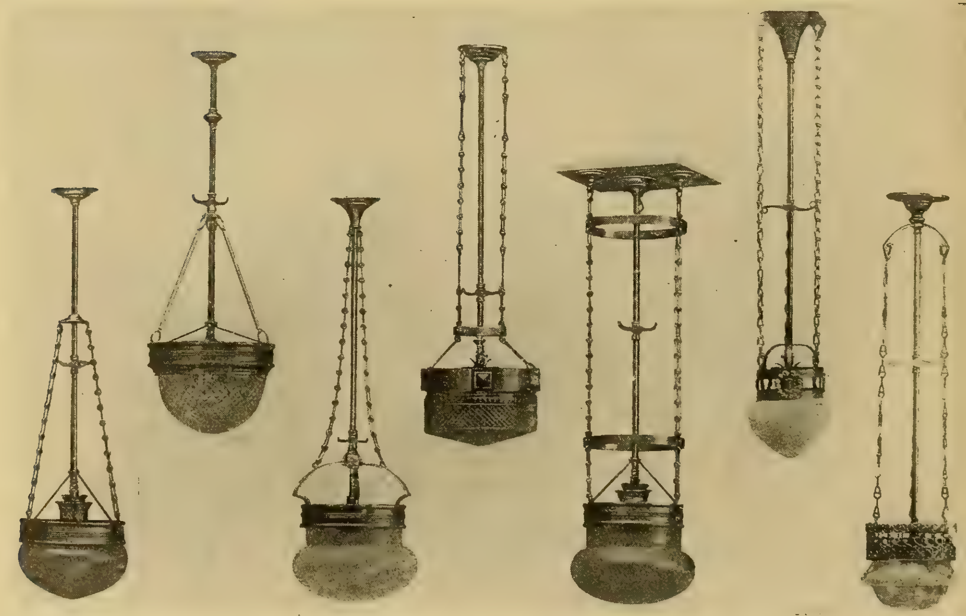


FIG. 13.—FIXTURES FOR INVERTED BURNERS WITH LARGE DIFFUSING BOWLS.

without the use of this double tube, is difficult, it is not impossible. Fig. 7 shows a simple but fairly successful solution of the problem, the decorative treatment being of the art nouveau school. The success of the design, however, results from the mechanical balance which is obtained by the curve of the tube supporting the burner and the smoke-bell.

Fig. 8 shows a successful design of the Louis XV. type, in which this balance is equally well preserved.

Figs. 9 and 10 illustrate a daring but clever use of the snake as the chief decorative feature.

Fig. 11 shows a conversion of the fixture into the form of a small lantern, which for certain purposes would be highly artistic and effective.

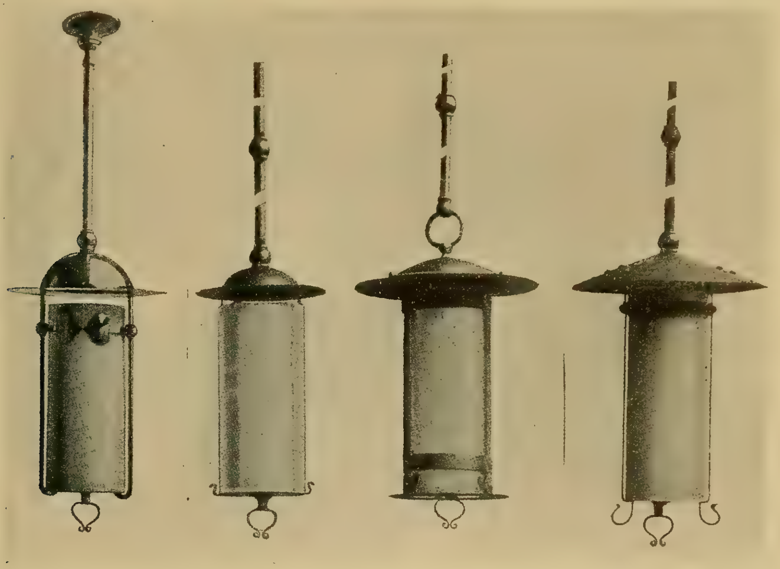


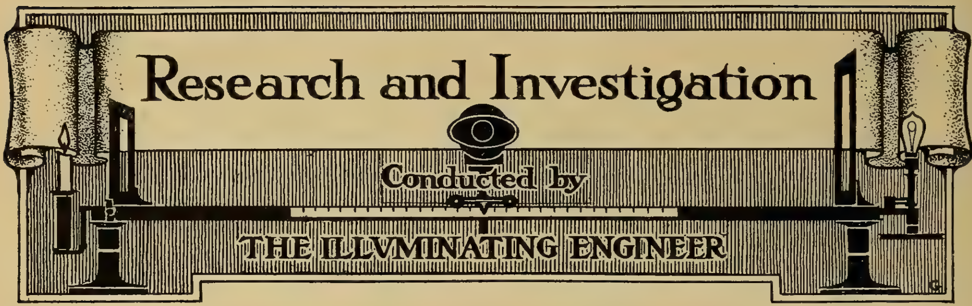
FIG. 11.—LANTERNS WITH UPRIGHT MANTLE BURNERS.

With the introduction of the inverted incandescent gas burner the double tube, or lyre construction, became unnecessary, and instead of the problem of making this symmetry pleasing, the designer faces the problem of the stiff central tube support.

Fig. 12 shows several methods of solving the problem with a particular form of burner and art nouveau decoration. The same general faults are apparent as in the one-light electric fixture, namely, the use of ornamentation which is obviously superfluous. The fact is that the single supporting tube is all that is required, and any additions to this fail to satisfactorily answer the question: "What is your purpose?" They are all excrescences; it is merely a choice between excrescences, *à l'art nouveau,* and excrescences *à l'art Américain.*

Fig. 13 shows a very much more successful solution of the problem, due principally to the use of large diffusing globes, which afford a legitimate opportunity for the use of additional supporting devices, which relieve the stiffness of the central tube. The designs are very characteristically the German conception of art nouveau.

Fig. 14 shows an entirely different method of attacking the problem. In this case the chain support, heretofore usually considered the exclusive property of the electric fixture designer, has been utilized for the support of the single inverted gas burner. In place of the flexible cord of the electrician a very fine copper tube is threaded through the links of the chain and affords a passage for the supply of gas. The gas burner itself is hidden by a reflector and flounced silk petticoat, which may or may not strike the observer as artistic. The metal work, which is kept as small in amount as possible and still preserve some semblance to artistic treatment, is of art nouveau form, representing hammered workmanship.




# A New Method of Comparing Color Values of Different Light Sources

The desirability of some accurate method of comparing, and if possible of measuring, color differences has long been recognized, and solutions of the problem have been offered by several experimenters, notably Abney, Lovibond, and Ives. The phenomenon commonly known as the "Purkinje" effect has also been carefully studied and frequently discussed, but so far as we are aware, without arriving at conclusions sufficiently definite to be expressed numerically.

The following simple method of investigating both of these problems is set forth more in the hope that others may follow up the line of investigation, than of giving actual results.

The apparatus required consists in a very simple modification of the original form of Lummer-Brodhun photometer. The screen, or observation surface, in this instrument, as is well known, consists of a disc of white plaster, the two opposite sides of which are rendered visible monocularly by a system of prisms and lenses, the one side appearing as a circle within the other. The photometric balance consists in causing the dividing line between the inner and outer circles to disappear. If the two light-sources are of exactly the same color, this disappearance is complete and of remarkable sharpness; but if there is the slightest variation in color, disappearance does not take place, and the judgment of luminous intensity must be made by comparison.

The delicacy of the disappearance method suggested that it might be utilized for the special purpose of detecting, and possibly measuring, color differences of various light-sources. For this purpose, a surface having a definite or given color is substituted for the plaster of the regular screen; for example, a strip of tinted paper or cloth may be doubled over the screen and inserted in the instrument; the doubling insures the same surface being exposed to both light-sources.

If the observation be now made in the usual manner the concentric circles will show the color which is produced by the two light-sources by which they are illuminated. In order to entirely eliminate the Purkinje effect, the intensities of the two light-sources should be brought to an equality by observation on the plaster screen and the usual setting of the instrument. If the light rays from the two given sources have the same value in reference to the color under examination the dividing line between the two circles will entirely disappear, but the slightest difference in color value of the rays will make such disappearance impossible, and the two circles will appear with the colors produced by the two different light-sources.

In comparing an artificial light with daylight it is only necessary to place one end of the photometer bench in line with a window and adjust the distance of the bench from the window so as to balance the intensity of illumination with that of the light-source under examination.

Perhaps the most striking result brought out by this method of investigation is the

extent to which the Purkinje effect influences color vision. This is made apparent by varying the intensities of the two light-sources used for the observations. It is generally understood that "in the night all cats are gray," but it will be something in the nature of a surprise to most observers to see to what an extent all objects become white, or rather appear as they do by white light, when the intensity of illumination is sufficiently high. By increasing the intensity of illumination sufficiently light-sources which are commonly accounted as having very distinct color differences will produce practically the same visual effect.

In order to arrive at results capable of numerical expression, the first necessity is the establishment of standard colors. For practical purposes, the three-component theory of color-vision may be accepted. The extent to which the three-color process is used in commercial art is a sufficient proof of the soundness of this theory. The three primary colors used in this process might be taken as standards with a considerable degree of definiteness. The intensity of illumination at which these would appear the same would afford a method of expressing the comparative color values of the two light-sources with some approximation to accuracy. It is possible that other colors and tints might be specified with sufficient accuracy by stating the particular aniline dye used in their production. The discoveries in the line of aniline, or coal-tar, dyes have rendered possible the production of an enormous variety of colors of remarkable purity.

The comparison of the color values of light-sources by spectrum analysis affords a very accurate method, but one which is generally beyond either the manipulative ability or the facilities at the command of the average illuminating engineer, and entirely beyond the comprehension of the layman. The method just described, on the other hand, is one which any observer can carry out who has access to a Lummer-Brodhun photometer, by no means an uncommon nor unduly expensive instrument. Furthermore, the results would be as easily observed and quite as satisfactory to the client as to the illuminating engineer himself. The method seems to open a field of investigation that may be explored with interest as a mere scientific recreation, if not of positive instruction.

## White Versus Black Letters in Printing

In our last issue we referred to the suggestion made by the printing paper manufacturers to reverse the present practice in printing by substituting white ink on black paper. The suggestion was made from purely commercial considerations. It is a matter of common knowledge that almost the entire supply of paper used by printers is made from wood, and the consumption of material has become so large as to seriously threaten the forests of spruce and pine, which alone are available for this purpose.

Printing ink is a composition of carbon with oils and gums, and consequently wholly resists all bleaching processes. Paper having been once printed cannot be used over again as a material in the manufacture of white paper. Newspapers, which represent the largest amount of paper, have practically no value as "scrap" paper. If, however, printing paper were black instead of white, all of this scrap could be utilized, and such paper produced at a very much cheaper rate than white paper. The practical difficulty lies in the production of a white ink.

Aside from the economics of the case, however, there is a scientific side which concerns illuminating engineers in particular, and the public in general. We noted the rather peculiar fact that Mr. Marshall had made the same suggestion in a previous issue of The Illuminating Engineer, that is, the use of white ink on black paper, but from the viewpoint of optical hygiene. Mr. Marshall's contention was, that the surface of the letters being much less in area than the unprinted surface of the paper, the paper rather than the letters should be non-reflecting, thereby largely reducing the total amount of light entering the eye.

In order to enable our readers to make a practical test of the matter, we have printed this page in the reversed method, that is, white letters on a black background. While it is perhaps not possible to form a conclusive opinion by this simple experiment, it may at least afford a means of forming an approximate judgment of the relative merits of the two methods.

# Theory and Technology

## A New Method of Determining Derived Photometric Quantities

By Norman Macbeth.

In the March number of the Illuminating Engineer I described a method of determining mean spherical candle power without the use of a Rousseau diagram, by the use of lines drawn at certain angles on the ordinary polar paper. The ease and rapidity with which the calculations can be made by this means, and the advantage of using a single sheet of paper and a single diagram in place of separate sheets for the polar and flux curves, suggested that it would be a convenience to illuminating engineers to have a paper prepared for the regular use of this method. To this end it was only necessary to prepare the ordinary polar paper with the lines for determining flux or spherical candle power values in such a way as not to be confused with the lines indicating the regular angles.

A sheet of the paper showing this arrangement is shown in Fig. 1.

While attention has been frequently called to the fact that the polar diagram as a graphic representation of *quantity* of light has no significance, and this fact should be sufficiently understood by illuminating engineers and those having even an elementary knowledge of the use of the graphic method of representing relations between variables, there are still doubtless many cases in which the layman connects the polar diagram with amount of light. This is really a most natural inference to make, since it is the surface included by the curve rather than the curved line itself that naturally first impresses one. The layman may be excused for such a mistake when the same error is made by those technically trained, an example of which recently appeared in one of the technical journals.

An interesting comparison, showing the peculiarities of polar diagrams, is shown in Fig. 2, where 150 mean spherical candle power is given three distributions, viz: uniform, maximum on the horizontal, and maximum in the (lower) vertical.

The relative values of the intensities at the different angles so far as total quantity or flux of light is concerned is shown by the shaded portion of surface included between the two curves ONDM and EEFF given in Fig. 3. The outer curve ONDM is that of an oval filament 16 c. p. lamp. The inner curve EEFF is determined by taking at each angle a distance from the outer curve which shall represent the comparative flux of light at this angle. The value at the horizontal (90°) being taken as unity. It may be noted that the flux value in the zone 18° around the pole is but 5% of the lower hemisphere, and within 45° it is but 30%. The length of the line between the two curves at any angle therefore represents the proportional value of the flux distribution.

This particular diagram is interesting from the amount of information which may be derived from it with minimum time and effort. From the outer candle-power distribution curve may be determined the mean spherical candle power;

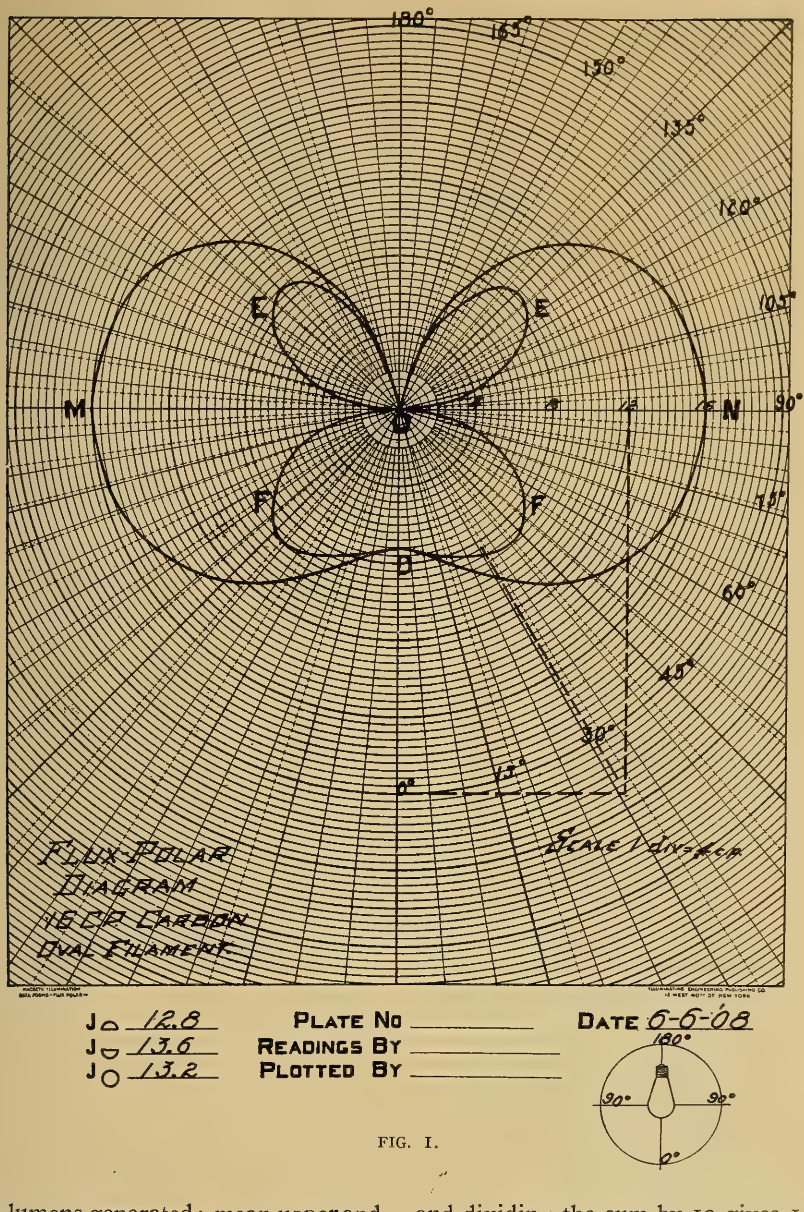



FIG. I.

the total lumens generated; mean upper and lower hemispherical candle power; upper and lower hemispherical lumens; the flux effective in 60° zone, and the normal illumination at any point. From the inner curve in the lower hemisphere may be determined the horizontal illumination values effective at any height and distance.

To determine lower hemispherical candle power read on DM or DN at the dotted radial lines on one side of lower hemisphere, which give in the example taken: 8.4, 10.4, 12.1, 13.3, 14.2, 14.9, 15.4, 15.6, 15.8, 15.9. Adding these 10 values and dividing the sum by 10 gives 13.6, the mean lower hemispherical candle power. The upper hemispherical readings on NO or MO are 15.9, 15.8, 15.6, 15.4, 15.0, 14.9, 13.0, 11.4, 8.6, 3.0, the sum of which when divided by 10 gives 12.8, the mean upper hemispherical candle power. The determination of the mean candle power in either or both hemispheres having been made, the reduction to lumens requires simply the multiplication of the hemisperical candle power by $2\pi$ (6.28) giving 85.41 lumens lower hemisphere, and 80.38 lumens upper hemisphere. The total

lumens is either the sum of both hemispheres, or the mean spherical candle power, multiplied by 4 $\pi$ = 165.79 lumens.

For the effective flux in the 60° zone, add the following readings, taken at intersection of dotted radial lines within 60°: 8.4, 10.4, 12.1, 13.3, 14.2, giving a total of 58.4; the mean of the five readings is 11.68, which multiplied by $\pi$ gives 36.7 lumens.

The tangent of 60° is 1.73; hence the radius of the zone may be determined by H (height) $\times$ 1.73; or having the distance, the height may be determined by D (distance) $\div$ 1.73. For a height of 5 feet the distance would be 5 $\times$ 1.73, or 8.65 feet. The area of the zone = radius$^2$ (or distance$^2$) $\times$ $\pi$ = $8.65^2 \times 3.14$ = 234.8 square feet. The average intensity of illumination is then 36.7 $\div$ 234.8 = .156 foot candles.

The illumination at a point 3 feet distant from the perpendicular with a source 5 feet above the plane, may be obtained as follows:

Place a cross section sheet of tracing linen or celluloid on the flux polar diagram, and read at the intersecting point of 5 feet height and 3 feet distance, the angle 31°, as shown by horizontal and vertical dotted lines in Fig. 1. The candle power intensity at 31° on the outer curve is 10.3, and on the inner curve 8.8

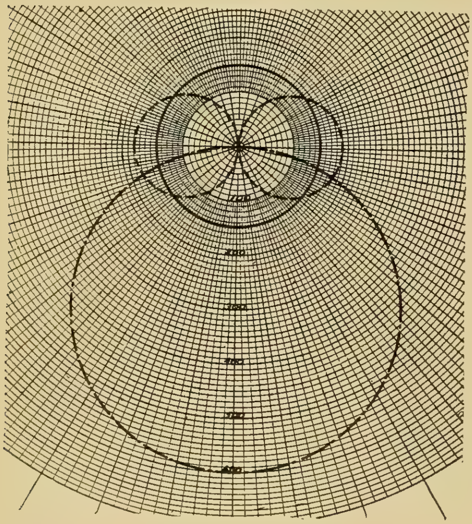


FIG. 2.

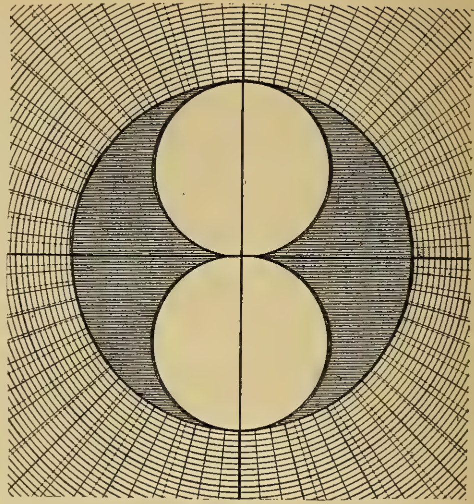


FIG. 3.

candle power. The usual equations for determining normal illumination are

$$I_n = \frac{cp}{D^2}, \text{ and } I_n = cp\,\frac{\cos^2 a}{h^2}.$$

The result also may be more quickly and accurately obtained by dividing the cp by the sum of $H^2$ and $D^2$, which for 5 feet height and 3 feet distance would be 25 + 9 = 34. $I_n$ would therefore be 10.3 $\div$ 34 = .303 foot candles, the intensity at this point. To obtain this from the diagram, $I_h$ would be 8.8 $\div$ 34 = .259 foot candles. Always use the outer candle power curve—OND or OMD—for normal illumination and the inner curve OFD — for horizontal.

To plot the inner curve read the candle-power on the polar distribution curve at the intersection of the dotted radial lines, using 95, 85, 65, 75, 45, 35, 25, 15, and 5 per cent. of the readings secured, beginning at the first dotted radial and reading from 0° to 90°, and from 90° to 180° read on NO or MO, using percentage in reverse order, 5% to 95%.

By the use of this paper and method the values with which to plot this curve can be readily taken, and have been found extremely useful and rapid as a "thumb rule method" for determining illumination values without the use of tables or slide-rule calculators.

# The Illumination of Shady Streets

By H. Thurston Owens.

In an article on the above subject in the May issue of this magazine, Mr. A. R. Dennington brings forward arguments against the use of arc lamps on shady streets, with which the author is in accord, but the superior method suggested contains statements which are open to serious question.

Mantle gas lamps do not require diffusing for the reason that their intrinsic brilliancy is not great enough to be objectionable. The distribution from these burners could hardly be improved for street lighting purposes, so that a prismatic enclosing globe would be a positive detriment, owing to the loss of light due to absorption. The most important portion of the street requiring illumination is the roadway, as a person in a fast moving vehicle requires the aid afforded by the street lamps to a much greater extent than the pedestrian, and furthermore, lamps placed along the curb will not cast shadows on the roadway, which are very confusing to a driver. Therefore the suggestion of placing bracket lamps "on the side of the pole next the walk" would not produce the most effective result.

Mr. Dennington states that from eight to twelve incandescents would be required to replace one arc, provided that they were located 100 feet apart, and further, that this number can be obtained for about the same amount of energy as one arc.

In order to illustrate that this cannot be done in practice, the lamps located as suggested and the proportionate cost is shown in the diagram,

Fig. 1 shows an arc lamp lighting 400 feet of roadway at an approximate cost of $100 per annum.

Fig. 2 shows a street equipped with twin 50 c.p. incandescents; these could hardly be obtained for less than $50 per post, per annum, therefore, the lighting arrangement suggested by Mr. Dennington would cost double that of arcs.

Fig. 3 shows an arrangement of single incandescents which can be obtained for $100 per year, provided 54 Watt, nominal 40 c.p. tungsten lamps were used.

Fig. 4 shows a similar arrangement with mantle gas lamps of nominal 60 c.p., at the same cost as the 40 c.p. incandescents.

The figures given are only used to give the relative values of the different styles.

The matter of equipment is an important consideration and in all cases there will be an additional installation expense, unless an unsightly equipment is used. Something like that shown in Fig. 5 can be obtained gratis, but the style shown in Fig. 6 will entail considerable expense.

Electric lamps equipped as those in Fig.

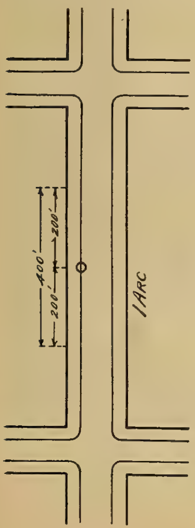


FIG. 1.

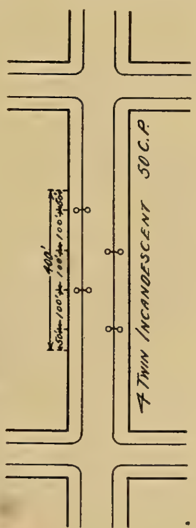


FIG. 2.

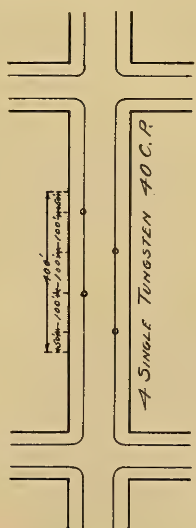


FIG. 3.

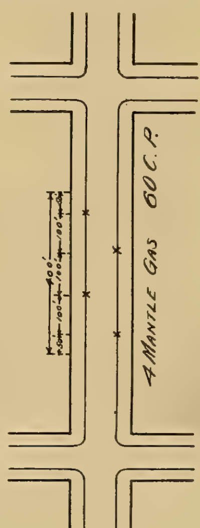


FIG. 4.

FIG. 5.

FIG. 6.

7, are very attractive, but very inefficient; the post can be used for either gas or electricity, and is far superior to the one shown in Fig. 8, equipped with mantle gas lamps.

In regard to the statement, " Renewal of the incandescents would be required only once or twice each year, depending upon the type of lamp used," the writer has evidently failed to take into consideration the fact that even were the shortest moonlight schedule used with the longest burning incandescent lamp on the market, two lamps per year would hardly suffice.

On an all-night schedule nearly five lamps per year would probably be necessary.

Flaming arcs with clear globes are, to say the least, decided novelties, and especially when used for street lighting, and it would doubtless be of interest to know where the installation is to be found.


FIG. 7.

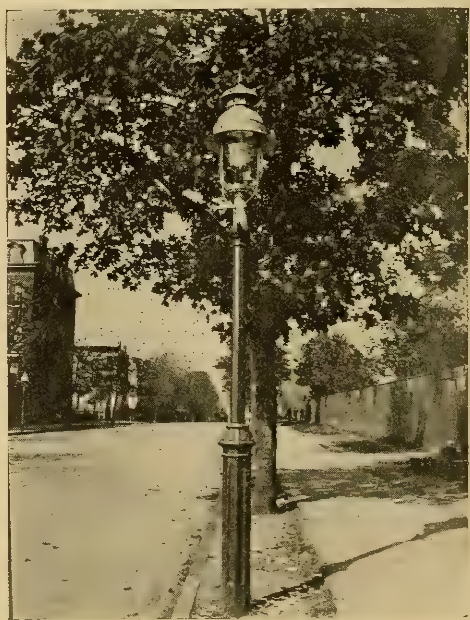


FIG. 8.

# Recent Progress in the Voltaic Arc

By Isidor Ladoff.

(*Continued*)

1. The improvement in the manufacture of incandescible bodies, which consists in dry-molding into the desired shape an infusible or substantially infusible metal of inferior conductive and high illuminating power and then surface-oxidizing the body so obtained.

2. An incandescible body consisting of an infusible or substantially infusible metal of inferior conductive and high illuminating power and having its surface coated with an oxide of said metal or metals.

3. An incandescible body made of a mixture of nitrid of titanium and high-resistance refractory oxides.

4. The manufacture of incandescible bodies which consists in forming such bodies of alloys of high-resistance metals and surface-oxidizing the completed body.

5. The manufacture of incandescible bodies which consists in forming the same of a mixture of refractory oxides, cellulose and chlorid of zinc, drying and flashing. The inventor limits himself to incandescent bodies for incandescent electric lamps, as he expressly states in his specification.

Letters Patent granted to Gustavos Heidel, No. 641,958, dated Jan. 23, 1900, refers to a negative pencil for arc lamps composed of aluminum while the positive pencil is composed of carbon.

The British patent granted Oct. 24th, 1898, No. 10,815, to Charles Ludwig Rudolph Ernest Menges refers to incandescent filaments for electric lamps and composed of intimate mixture of a substance having metallic conductivity with a substance not having metallic conductivity. The conductive substance may be a metal or carbon or a *carbide* or the like. A non-conductive substance or insulator may be an oxide of an alkaline earth or of an earthy oxide, or nitrate boron or like substance capable of sustaining a very high temperature. He mentions *titanium, vanadium, uranium, carbides of this metal or a mixture of the metals.* These substances are *mixed with the oxides.* The filaments are gradually heated in the absence of air to a sufficiently high temperature to make the carbon therein an electric conductor, and then mounted upon platinum wires of the electric circuit and heated by an electric current in vacuo in a suitable gas (?) until a reduction of the titanic acid to metallic titanium or to titanium carbide, takes place. The claims are as follows:

1. The manufacture of an incandescent conductor composed of an intimate mixture of metals or metallic carbides with oxides by mixing together a chemical compound of the metal, carbon and the oxide, forming such mixture into the shape of the incandescent conductor, baking it till the carbon becomes electrically conductive, and then heating it by an electric current till the metal or the metallic carbide is reduced from the compound.

2. An incandescent conductor for an electric lamp containing an intimate mixture of *metallic titanium,* or *titanium carbide,* or *metallic vanadium,* or *vanadium carbide,* or *metallic uranium* or *uranium carbide,* with the oxides.

It is obvious that the carbon base of this filament is intended to produce a chemical combination, a carbide and not remain uncombined chemically.

The German patent No. 116,141, to Carl Pieper, Berlin, issued Nov. 24, 1900, relates to incandescent bodies that may be heated to the strongest white heat without any deterioration caused by the action of the current, and consequently transform the greatest part of energy into light. These bodies consist in the main of mixtures of metals distinguished by a high light emissibility as by their high melting point, namely thorium or *titanium,* in the shape of *metallic titanium* or *titanium nitride* or graphite with thorium oxide with or without an addition of cerium oxide. The inventor claims an incandescent body for incandescent lamps consisting of mixtures of thorium metal, *ti-*

*titanium metal* or *titanium nitride,* or graphite of high density with thorium oxide with or without the addition of cerium oxide. He does not mention any *oxide of titanium,* and the metal titanium is recommended not on account of its luminous quality but on account of its high melting point. This is obvious from the second claim relating to the process of manufacturing incandescent bodies. In this claim, he distinguishes his process by an addition of small quantities of metals of *high melting power,* as chromium, wolfram, to the metals thorium, titanium respectively, titanium nitride for the purpose of manufacturing the same *by lowering the melting point* of the mixture. In an additional claim, he specifies that he does not use any binding material whatever in the manufacture of his filaments.

George Alefield received Letters Patent No. 656,077, dated August 14, 1900. This invention relates also to incandescent materials for electric lighting. In his specification he cites the Jablochkoff candle and Nernst lamp as instances of lamps having high luminosity, but objectionable on account of the mode of preheating. His ambition is to improve upon this particular kind of lamps. Incandescents are made of a suitable body composed of one or more of the "luminous earths," and a film-like partial coating of one or more of the highly infusible metals of the platinum group to constitute a practically indestructible preliminary conductor, and it is in practice used in connection with a suitable electric contact which may answer for both the body and the conductor, with or without an enclosing bulb. As material for his incandescent bodies, he uses one of the oxides of the earthy metals which become luminous at an elevated temperature, as for example lime, baryta, strontia, magnesia, oxides of thorium, cerium, zirconium, erbium, etc. He claims to have obtained best results with a hollow cylinder of magnesia mixed with 20 per cent of oxide of thorium containing about one per cent of cerium coated with osmium. However, he states that instead of magnesium, lime, baryta, any of the mentioned earths may be used, or the coating may be of tuthenium or rhodium, and good results obtained.

*Classification of Luminous Arcs (arcs à flamme) into two categories.*

From the preceding follows, that it is possible from the point of view of the present essay, to classify the luminous arc into two categories, very clearly differentiated by the nature of the substances employed and the phenomena predominating in the process of the light production. On one side there are the flaming arcs composed of (the vapors of alkaline and earthly alkaline chemical compounds or of other compounds giving white fumes, raised to *incandescence.* On the other side we have to do with arcs formed between metals or their compounds of the iron or titanium groups, not enjoying such an advantageous degree of light emmissivity by simple incandescence, but which give above all, place to the effect of luminescence.

*II. Lamps of the First Category, of Incandescent Flames (Alkaline-Earth Compounds)*

These lamps were realized in practice in three shapes: with electrodes of pure oxides, with mineralized carbons surrounded or not with a protecting outward layer of pure carbon, finally with pencils of pure carbon with mineralized cores containing luminescent salts (sals eclairants).

*Electrodes of Pure Mineral Substances.*

The employment of arc light electrodes composed of pure mineral substances proposed by Raasch and recently introduced into France by the "Campagnie Géneral d'Electricité," did not seem to develop into an industrial success and represents at present only a theoretical interest.

The authors used at the ordinary temperature more or less insulating pencils (batonnets), that had to be preheated a certain time. The obtained arc was pretty (beau), but of a composition less favorable than the arc produced by fluoride of calcium. When instead of the latter, other oxides or compounds are added, imparting some conductibility to the mass, the electrodes turned too fusible. However, at any rate, the loss of voltage is so considerable that it occasions an excessive loss of energy. Finally, as is seen from Fig. 2, the voltage among terminals varies so much faster than with other arc light pencils, that the regulation would require a precise mechanism. These practical inconveniences are so far not overcome. (Biegon de Chudnochowsky Verh. d. Physiclischen Gesellschaft, 20, March, 1903.)

Bulletin de la Société Internationale des

Electriciens, V, VII (2nd series), March, 1907, André Blondel.

Ewald Raasch did a great deal of work in the line of electric light arc lamps, and we will refer to his work more extensively later. At present we will only note his German patent No. 137,788, which is an addition to his principal patent, No. 117,-214. His invention in that particular case refers to a preheating device similar to that of Jablochkoff. This device consists of two auxiliary electrodes, so arranged that between them an arc can be formed without any preliminary heating. As such auxiliary electrodes, he recommends carbon mixtures of conductors of the first and second class, *metallic carbides,* silicides or borides relatively well conducting *metallic* oxides, mixtures of these oxides of metallic salts, etc. The auxiliary pencils must be so arranged as to surround the luminescent electrodes composed of conductors of the second class. This inventor claims in his patent *electrolytic electrodes* surrounded by auxiliary electrodes of better conducting material for the purpose of preheating the luminescent electrodes composed of conductors of the second class.

The Danish patent No. 2,420 was issued August 7th, 1899, to Dr. Carl Auer Von Welsbach, for the manufacture of the Osmium filament. This patent is an addition to No. 2,095, issued July 24, 1899. In the process of manufacturing osmium filaments, he prepared a plastic mass composed of a homogeneous mixture of extremely *finely divided Titanium Oxides,* ten parts by weight of Osmium to four parts by weight of Titanium oxides. The Titanium oxides can be replaced in the mass by others, such as unstable oxides in a fierce white heat, of a more basic character, such as aluminum oxides or magnesia or silicic acid. The threads are brought into the desired form, and thereupon they undergo a "Dry Distillation" so that there is thus produced a body in the form of a filament consisting of Osmium-Titan-oxides and carbon. The thread is fastened in a temporary frame, and it is gradually heated in a reducing mixture of gases by an electric current until the carbon contained therein is burned out. The temperature is thereafter in the course of time increased by means of the electric current to a white heat, so that the Titanium oxides melt and the filament becomes dense, and finally, the temperature is further increased, by which the Titanium oxides become volatilized while the Osmium particles come closer and closer together and are thus combined into a thoroughly dense and elastic filament. He expressly states in his specification that the carbonaceous materials burned out and the oxides of titanium, unstable at the dazzling white, disappear. The titanium oxide is here used only for the purpose of making the osmium filament more dense. In his claim 2a, the inventor expressly states that the addition of oxides unstable at the bright heat, such as titanium-oxide, aluminum-oxide or magnesia, is done especially for the purpose of removing them at a still higher temperature by volatilization.

Carl Ochs received Letters Patent No. 648,518, dated May 1, 1900. His invention relates to heating resistances for glowers of second class conductors in glow lights. His heating resistance is composed of oxides of metals, possessing extraordinarily high vaporizing temperature, or melting point, and when in this condition emit light. Such oxides of metals are, for instance, the following: oxide of iron, oxide of copper, chromium oxide, uranium oxide, oxide of manganese, oxide of nickel, oxide of cobalt, titanium oxide, tungsten oxide, molybdenum oxide, etc. The production of light in this heating resistance is of secondary importance, if of any. He recommends the addition to the plastic mass of which these glowers are made, strongly slagging materials, such as porcelain earth, magnesia, etc. Such strongly slagged little rods or tubes are provided at their ends with conductors of difficultly melting metals, such as platinum or nickel. In this form, they can be used as resistances, or as light giving heating bodies, but in the latter case must be provided with an initial resistance in series therewith, because at a high temperature they have a negative conducting temperature and it is necessary to compensate for the change of resistance. Such glowers or heating resistances are of great use in lamps similar to the Nernst lamps.

A number of patents were issued to William Lawrence Voelker, No. 679,803, dated August 6, 1901, Letters Patent No. 679,926, dated August 6, 1901, Letters Pat-

ent No. 683,085, dated Sept. 24, 1901, and No. 683,086, dated Sept. 26, 1901. The patents relate to a method of producing carbide filaments for electric incandescent lamps consisting in treating a carbon filament in an electric arc in the presence of vapor of the metal or metals constituting the metallic base of the carbide to be produced, the said carbon filament being converted into graphite and then into carbide at a single operation. The metals he intends to turn into carbides are uranium, *titanium*, zirconium or beryllium. The other patents are simply an elaboration of the same basic claim.

Alexander Just received Letters Patent No. 663,095, dated Dec. 4, 1900. The invention relates to the manufacture or production of electric incandescent bodies that have a high resistance and are not appreciably influenced by an increase of temperature. Such bodies, according to this invention are made from a mass comprising or containing a conductor or conductors of the first class, especially carbon, boron, or silicon, and the nitrids of boron or silicon, that means, boron-nitrid or silicon-nitrid. These nitrids represent conductors of the second class, but they have such a small conductivity even at the highest temperature occurring in the electric glow lamp, that they may be considered non-conductors. Of the nitrids mentioned, nitrid of boron is of especial value in the manufacture of the incandescent bodies in question, in consequence of the ease with which it can be prepared. Furthermore, nitrid of boron fulfils all the requirements of a substance intended for use in electric glow lamps, as it is infusible at the highest temperatures occurring in such lamps, is non-volatile, and is inert in a high degree. The claims are as follows:

1. An incandescible body composed of an intimate mixture of a conductor of electricity and a refractory nitrid of a metalloid.

2. An incandescible body comprising a mixture of nitrid of boron, silicon and a carbonaceous material.

3. An incandescible body comprising a mixture of nitrid of boron and carbon.

4. An incandescible body comprising boron, carbon and nitrid of boron.

5. An incandescible body comprising boron, silicon, carbon and a refractory nitrid of a metalloid.

Robert Hopfelt received Letters Patent No. 700,649, dated May 20, 1902. The main object of this invention is the manufacture of electrodes for arc light of carbides which are decomposable by water, especially the metallic carbide and particularly carbide of calcium. In order to make such a carbide electrode of a high conductibility, he incorporated into the body of the carbid electrode a substance having good conductive properties, viz: finely divided *metal dust*, a wick, a *solid carbon within the carbid electrode or metallic wire*. The claims are as follows:

1. An arc light carbide electrode, consisting of a carbide decomposable by water and a conducting substance incorporated in the body of the carbide, and a superficial coating of a body impervious to water.

2. An arc light carbide electrode, consisting of a carbide of calcium, a conducting substance incorporated in the body of the carbide and a superficial coating of a body impervious to water.

3. An arc light electrode, consisting of calcium carbide and carbon dust mixed therewith, and a superficial coating of a body impervious to water.

4. An arc light carbide electrode, consisting of carbide decomposable by water and carbon mixed therewith and a metallic wire imbedded in the electrode.

Charles Denton Abel received Letters Patent No. 12,162, dated May 28, 1902. The invention relates to the manufacture of filaments for electrical incandescent lamps from vanadium, tantalum or niobium, or alloys of these metals with each other or with other metals. For this purpose, the filament is formed from a mixture of carbide and oxide of one or more of the metals in question, and is heated to cause the oxide and carbide or dioxide. The proportion of carbide to oxide is so chosen that no free carbide or oxide remain in the finished filament. The heating may be either by an electrical source of heat, as for instance, in the electric furnace, or by the passage of an electric current.

*To be continued.*


## The Thirty-fiirst Convention of the National Electric Light Association

The convention was a success. There is no need to specify what convention to any one who has any interest in the lighting industries. *The* convention is the annual convention of the N. E. L. A.—that is understood.

Viewed either from point of numbers in attendance, from the variety and importance of the papers and discussions presented from the capital invested in, and importance of the industries represented, of which lighting forms the larger part, or from the general results to which this annual gathering gives rise, the convention is without doubt the event of chief importance of the year.

The large number in attendance, which exceeded by nearly 200 the highest records of previous conventions, is naturally one of the first features to attract attention. While the central location of the place of meeting may have contributed to this, the fact is nevertheless exceedingly gratifying from every point of view, as indicating not only continued, but increasing interest in the work of the association. The growth of the electrical industries in this country for the past quarter-century has been nothing less than phenomenal, and the parallel growth of the association which represents this rapidly expanding commercial field speaks well for those who have, during the preceding years, been responsible for its management.

The months immediately preceding the convention, it must be admitted, have not been such as to tend particularly to elation of spirit or to a general optimism in regard to business; but so much the more need for "getting together." It is absolutely impossible for Americans to be blue or disconsolate when they are together in any considerable number. If "misery loves company," the meaning of company must be taken in accordance with the saying, "two is company, three is a crowd." Who ever saw an American crowd miserable under any circumstances?

The man who attended the convention and did not come away with a more cheerful outlook, and a general feeling of renewed energy and courage, is in serious need of a strong liver tonic or of moral regeneration. This renewal of faith and inspiration which comes from attendance at the convention, and which is recreation in its true sense of re-creation, is by no means one of the least advantages to be obtained from membership in the association. The papers and discussions are all printed, and appear duly in beautiful blue and gilt covers some time during the course of the year; but who goes to them as a source of hope or encouragement in a moment of business or professional depression? Valuable data they contain, beyond doubt; but as a source of inspiration and encouragement, one would no sooner think of resorting to the "Proceedings" that of consulting the encyclopedia to assuage the pangs of unrequited love.

Even though you have the printed copy of the paper before you, and the words of the reader reach you only as an inarticulate lullaby, there is still much to be gained from *seeing* the paper presented; and still more to be gained from the discussion, particularly if you take part in it yourself. Then, at least, you are sure of something interesting being said.

The social side of the convention must

not be lost sight of. The combination of business and pleasure on these occasions is certainly no infringement of the Sherman anti-trust law. The various pleasant events of the week are in no need of Federal regulation. The participants invariably take care of the occasion with eminent satisfaction to themselves, and that is sufficient.

To miss the convention is to miss something that is really worth while, viewed from any point you please to take.

## "Killing the Goose"

While it is perhaps not in the best taste at present to refer to the late unpleasantness in the financial world, we cannot help noting the fact, so clearly brought out in the discussion of "The Evolution of New Business Building," in the "Commercial Day" program, as to the unwisdom of shutting off the soliciting of new business departments of lighting companies during times of financial or business depression. We endeavored to impress this fact upon our readers during the actual stress of the storm by means of pictorial representation. We cannot claim any particular originality for the idea portrayed; in fact, a certain well-known citizen of ancient Greece, by name Æsop, showed the folly of killing the goose that lays the golden eggs; and yet, like many another piece of undoubted wisdom, the advice has been rejected on innumerable occasions since, and the slaughter of the goose bids fair to continue for ages to come.

It would seem a most natural conclusion that the greater the danger of losing business, and the greater the difficulty of obtaining new business, the more urgent the need of maintaining those forces whose purpose is to preserve and extend the business of the lighting company. And yet in an incredible number of cases, the partial or entire suppression of the new business department was the first act of retrenchment indulged in. From a number of cases cited in the general discussion referred to, the fact is clearly brought out that where new business departments were maintained at their full strength, the business of the company, even during the most strenuous months of the depression, was either fully maintained, or actually increased.

The companies which decapitated the goose in their mistaken zeal to retrench have now to rebuild, to a greater or less extent, from untried raw material which it will be the work of years to season into the most efficient condition, a new structure for which only the foundation, and very likely a cellar full of débris, is at hand.

The American, however, is a notoriously good forgetter, especially of troubles and disasters, and unquestionably the new structures will rise and in due course achieve even finer proportions than those which were swept away.

## Specifications for Street Lighting

With the report of Mr. W. D'A. Ryan, presented at the recent convention, the work of the committee appointed in 1906 to consider specifications for street lighting is concluded. Mr. Ryan's report consisted practically in a tabulation of the results of a large number of photometric and illuminometer tests of the several types of arc lamps now in general use for street lighting. The object of these tests was to arrive at a practical ratio of illuminating values between these different types of lamps. The following are the ratios arrived at:

| | |
|---|---|
| 6.6-amp., d. c., ser. open arc | 3½ |
| 9.6-amp., d. c., ser. open arc | 4 |
| 5.0-amp., d. c., ser. enc. arc | 3½ |
| 6.6-amp., d. c., ser. enc. arc | 4 |
| 5.5-amp., a. c., ser. enc. arc | 3 |
| 6.6-amp., a. c., ser. enc. arc | 3½ |
| 7.5-amp., a. c., ser. enc. arc | 4 |
| 4.0-amp., d. c., ser. lum. lamp | 5½ |

It is interesting to note that two modern lamps are given the same value as the old so-called "standard 2000 c.p. lamp," which figured so prominently in the Colorado Springs controversy, and which has been more or less a bone of contention in street lighting contracts ever since the introduction of enclosed arc lamps. The two lamps given as equivalents are the 6.6 ampere direct current enclosed arc, and the 7.5 ampere series alternating enclosed. It may be recalled here that the latter lamp was taken as a modern equivalent of the old style 9.6 ampere direct current open arc in arriving at the final award in the Colorado Springs case.

Another interesting point in the report is the value of 5½ given to the luminous, or metallic arc, lamp. If the proposed ratios were accepted it would therefore be possible to exceed the requirements in con-

tracts calling for the "standard 2000 c.p. arc," by the use of luminous arcs, with a less expenditure of electric energy than that used in the older form of lamp.

Mr. Ryan states that "preliminary tests were made with the luminometer and the street photometer, and the results checked fairly well, but the latter proved more satisfactory to operate and was used exclusively thereafter." There is an unfortunate looseness in the use of terms referring to different types of instruments for measuring light. Mr. Ryan seems particularly fond of coining new words to fit new instruments of his own designing. Presumably what he means by "luminometer," as used in his report, is the instrument which he has described in previous publications, and which depends upon acuity of vision in reading various sizes of type printed on white cards, for the results obtained. The measurements made were therefore simple photometric observations of the lamps in place in the streets, the instrument being placed at a distance of 250 feet from the base of the lamp. Presumably the normal intensity was the one observed. In other words, the tests consisted in measurements of the intensity of the rays from the different types of lamps within the angles of 83 degrees to 86½ degrees from the perpendicular. This is in accordance with the recommendations contained in the report of this committee made to the convention a year ago.

In controversies concerning the relative values of the different lamps, mean spherical, and especially mean lower-hemispherical candle power has heretofore played the leading rôle, which accounts for the poor showing that the enclosed arc lamp has always made as compared with the old open arc. The greater fluctuations of the open arc and the consequent difficulty of obtaining an average which should take the time element into account, has introduced an indeterminate correction factor which has been very difficult to evaluate. Any one who has looked into the matter at all has recognized the fact that the actual illumination values of the enclosed and open arc lamps were by no means in proportion to their mean spherical candle powers. The ratios given in Mr. Ryan's report, which represent the results of some 15,000 observations, unquestionably furnish a fairer basis of comparison than any figures heretofore given, and there seems to be no reasonable grounds for objecting to their acceptance as a basis for the commercial rating of arc lamps for street lighting purposes. What view the courts would take of these ratios, however, in case of actual legal controversy, remains to be seen; but as the N. E. L. A. recommendation as to what constituted a standard 2000 c.p. arc was accepted as authoritative in the Colorado Springs controversy, there is little doubt that the recommendations in Mr. Ryan's report would be likewise accepted by any court or arbitration board.

In the report presented by Mr. Farrand to the 1907 convention, the following statement appears:

"Your committee, after a most careful consideration of the difficulties to be met, and for the purpose of establishing a definite basis, assumed: That, inasmuch as the lighting of streets by contract is a matter of *illumination produced* rather than of *apparatus employed*, the terms used in specifications should be in terms of illumination and not of energy consumed; that the individual lamp of each class should be the unit of number charged for; and that the average illuminating power of each unit should be comparable with and have a value equal to a known standard at proper relative distance."

While the completed report of the work of this committee, including the figures presented by Mr. Ryan, constitutes a step toward the use of "illumination produced rather than of apparatus employed," as a basis for street lighting specifications and contracts, it nevertheless falls far short of fully accomplishing this declared purpose. The total result of the two years' labor of the committee amounts to this: Lamps used for street lighting should be evaluated by the relative intensities of their rays within angles of 83 to 86½ degrees from the vertical; in the case of arc lamps these comparative values are as given in Mr. Ryan's report.

In view of the progress that has been made within the past year in instruments for measuring illumination, have we not arrived at that stage of accuracy in illumination measurements where street-lighting contracts can be actually based upon "the illumination produced" in some specified manner upon the streets? It is our opinion that such a basis for contracts is possible.

## The Precision of Photometric Measurements

The charge has often been made against illuminating engineering that it is not an exact science; in fact, that the limits of error in the measurements with which it is concerned are so wide as to preclude it from the ranks of science altogether.

While photometric measurements, which consist only in determining the intensity of light rays in some specified direction, are by no means the only ones concerned in illuminating engineering, they form the mathematical basis upon which it is founded, and hence the limits of error in photometry have an important bearing upon the subject of the exactness of illuminating engineering as a science.

The paper entitled "Some Observations on Photometric Precision," by Professors Kennelly and Whiting, read before the convention, is particularly valuable and interesting to illuminating engineers, as giving not only the most recent researches in this direction, but also the results along a line of investigation that has never before been followed.

The investigations were made for the purpose of determining the limits of error of observation of different observers on the same instrument, and with different instruments. Four different types of photometers were employed, which include all the types that are in practical use at the present time, namely, the "grease-spot," or Bunsen, and three forms of the Lummer-Brodhun. In each case the observations included the comparison of light-sources of the same color value, and of those of somewhat different color values. The time required for the different observers to make the settings was also recorded.

When the light-source was measured against a standard of similar color value, the average "probable error" of a single measurement, made on the four different types of photometer, was as follows:

| | Per cent. |
|---|---|
| Grease spot | 1.52 |
| Lummer-Brodhun "Concentric" | 1.04 |
| Lummer-Brodhun "Equality" | .078 |
| Lummer-Brodhun "Contrast" | .46 |

The three forms of Lummer-Brodhun photometer differed in the method of making the balance. In the "Concentric" form the two illuminated surfaces appear as concentric circles, and the balance is made by the disappearance of the dividing line. In the "Equality" form the screen is divided into two adjacent semi-circles; the balance is made by a combination of the disappearing and equalizing methods. In the "Contrast" form there are practically two observation surfaces somewhat similar in arrangement to the Concentric, the setting being made by bringing the contrasts of the two parts of each half of the screen to an equality.

The above figures bring out the interesting point that the latest form of Lummer-Brodhun photometer is over three times as accurate for lights of equal color value as the familiar grease-spot instrument, and also that the average probable error of such a measurement is less than one-half of 1 per cent.

When the measured and standard light-sources vary in color values by the difference between a low-efficiency carbon filament lamp and a tantalum lamp run under normal conditions, the average probable errors were as follows:

| | Per cent. |
|---|---|
| Grease spot | 1.94 |
| Concentric | 1.46 |
| Equality | 1.91 |
| Contrast | 1.41 |

In this case it will be observed that the relative accuracies of the different instruments are nearly the same, and as would be expected, the average error is measurably larger. With two of the instruments, however, the error was less than 1½ per cent. The difference in color values in this case was larger than is usually necessary in photometric measurements. On the whole, therefore, it would be quite safe to say that photometric measurement may be usually made with a probable error not exceeding 1 per cent. The discrepancies in the settings of the different observers with the grease-spot photometer, however, were as much as 7 per cent. in some cases, but with the most precise form of Lummer-Brodhun photometer the agreement between the average settings of different observers was very close, in the case of lights of similar colors varying from one-tenth of 1 per cent. to three-quarters of 1 per cent. In the case of varying colors this difference increases up to over 10 per cent. with the grease-spot photometer. Under the most unfavorable conditions photometric measurements represent a very fair degree of precision and

consistency; and under conditions which are by no means difficult to secure, such measurements compare very favorably with the ordinary run of physical measurements. Photometry, at least, may therefore be fairly considered as among the exact sciences.

## Large vs. Small Units

This much discussed subject was revived in a paper on illuminating engineering by Mr. W. D'A. Ryan, presented to the convention. His position in the matter is summed up in the following: "Broadly speaking, the illumination of rooms having considerable dimensions can most satisfactorily be accomplished by the use of units sufficiently large to correspond with the surroundings." Mr. Ryan then particularly refers to department stores, in which the ceilings are generally structurally divided into "bays," or panels, of considerable size, and maintains that a better general effect is produced by the use of single units—and by unit must be understood either a single light or a collection or cluster of lights on a single fixture—in each bay; and similarly for other large spaces.

While some may be inclined to accuse Mr. Ryan of a partiality for large units, born of his connection with the arc lamp, they will find difficulty in successfully controverting his dictum in the present instance. Considered as a part of the general architectural features of a building, a single unit to a panel unquestionably produces better harmony than a multiplication of units promiscuously distributed. Architects will undoubtedly be found to agree with Mr. Ryan in this respect.

From the illuminating engineering standpoint, the fact must be taken into consideration that a light-source unavoidably affords a point of attraction for the eye. On account of their brilliancy the eye will unconsciously observe such points in distinction from all other objects in the field of vision. The observation will thus be divided between the luminous sources and the objects which are being illuminated: the greater the number of luminous points the greater the amount of attention they will receive, and the less the attention given to the illuminated objects. If the multiplication of light sources, therefore, is carried beyond a certain point, they afford an actual distraction of the eye from the objects which are especially intended to be seen. This fact is well illustrated in the designing of spectacular illumination, the avowed purpose of which is to fascinate the eye by means of the lights themselves; in such cases, the largest number of sources which can be used without blending into a single impression produces the highest effect. On the other hand, where a large number of individual sources are used for special lighting, as occasionally in large offices where desk lights are provided, or in workshops, where individual lights are furnished for each operator, the sources are concealed from general view by means of opaque reflectors; otherwise the numerous sources would be wearisome to the eyes, since they produce a corresponding number of intensely bright spots on the retinal image.

The one theoretical advantage of the small unit that has been most dwelt upon it that of securing a more nearly uniform ilumination; but this advantage is more theoretical than practical. In the first place, with modern accessories it is possible to obtain equally good results as to uniformity from reasonably large units; and in the second place, absolute uniformity is by no means always to be desired. It is generally conceded that daylight furnishes the model for perfect illumination; this, in the case of interiors, is always received through windows which, as compared with artificial lights, are generally few in number. There is thus a preponderance of intensity from one direction, which produces the shadow effect which is absolutely essential to perspective and relief, which are such important elements of vision.

The question of large versus small units therefore simmers itself down to a question of large versus small space-units to be illuminated, and, generally speaking, there should be a just proportion between the two.

## What Are You Going to Do About It?

In American commercial warfare the competitor seldom attempts to take his opponent by assault, but prefers the less bloody and much more elegant process of routing him by strategy. The electric and

gas light interests show very few, if any, evidences of open warfare, but it must not be inferred therefrom, at least so far as the electric lighting interests are concerned, that they are not fully awake to the situation, and keenly alive to every strategic advantage to be gained.

The latest weapon of electricity, and one which promises to be more effective in its results than any hitherto produced, is the tungsten lamp. So long as electric light cost from three to six times as much as gaslight, there were certain classes of illumination which the electric interests had very small chance of capturing with the only weapons then at their command—greater convenience and adaptability. But with the cost of electric lighting cut to one-third of its previous rate, conditions are very materially changed.

The tungsten lamp is no longer a theory nor an experiment, but an accomplished commercial fact; and not the least among the many resulting advantages, which the electric interests recognize to the full, is that of more successfully competing with gas in its own stronghold of economy. "It will enable us to compete successfully with the gas arc," was a sentiment repeatedly expressed in the general discussion of the commercial significance of the tungsten lamp at the convention.

Those interested in seeing gas illumination maintained, if for no other reason than the maintenance of a healthy competition, may therefore well ask of the Gas Companies: "What are you going to do about it?" "Are you going to let the electric lighting interests take your strongholds in detail, and leave you only the fields of heat and power in your uncertain possession, or are you going to fight them with their own weapons,—namely, improved forms of lamps and apparatus?"

The limit in efficiency in gas lighting has by no means been reached, nor have the means of rendering it more adaptable and artistic been exhausted. But there is no time to lose. Self-congratulation over past glories will not suffice to convince the user of light that the latest forms of electric lamps are not on the whole more advantageous than gas lamps. More than at any time in the previous history of the gas industry is there now necessity for the prompt and intelligent utilization of every possible advantage pertaining to gas illumination.

The electrical interests are almost wholly responsible for the foundation and phenomenally rapid growth of Illuminating Engineering as a science; the gas interests can no longer safely neglect this powerful ally.

The electrical interests have been exceedingly alert and progressive in working out valuable accessories for the distribution and utilization of light from their various lamps; the gas interests have been slow followers in this direction.

The electrical interests have been aggressive and original to a degree in designing artistic and efficient lighting fixtures; the gas interests, with few exceptions, have been content to perpetuate the fixtures of their forefathers.

The electrical interests have utilized almost to the full the power of advertising and publicity to arouse public interest in the use of electricity for light and other purposes; the gas interests have generally depended upon their prestige and inertia to keep them moving.

With the odds in point of economy so greatly in their favor, the gas interests have heretofore held a large amount of business with little or no special effort, but both in exterior and interior lighting the tungsten lamp has wrought a decided change in conditions.

The situation for the gas interests is one which demands immediate, thoughtful and vigorous action, if they are to remain in the field as an important factor in illumination.

# Correspondence

## From Our London Correspondent

Every day brings some new invention to place gas, as an illuminant, in line with electricity. Only within the last few weeks London's High Priest of Magic and Mystery,—Prof. I. N. Mashelyne,—has patented an invention for turning gaslights up and down by the opening of a door, a principle that has for many years been perfected in connection with electric lighting.

Every maker of inverted gas burners does his best to keep the fittings cool, and so reduce the tarnishing effects from the products of combustion. Many excellent fittings have been made by which the products of combustion are deflected, and so dispersed, the angle at which these deflectors or baffles are fixed regulating the angle at which the products pass into the atmosphere. Messrs. G. Hands & Co., of London, have patented what they term a "cool inverted burner," which we illustrate in Fig. 1. This is accomplished by the simple expedient of inserting a short length of asbestos tube between the mixing chamber and the down tubes of the burner. This method is so successful that after several hours of using the mixing chamber is quite cool enough for the most delicate fingers to handle. It will be noticed in our illustrations that the deflector wings are fixed at an unusual angle, which also assists materially in keeping the mixing chamber and fittings cool. We understand that the "Hands" inverted burner gives a flame of perfect incandescence, with an efficiency of about 23 candles per cubic foot of gas consumed.

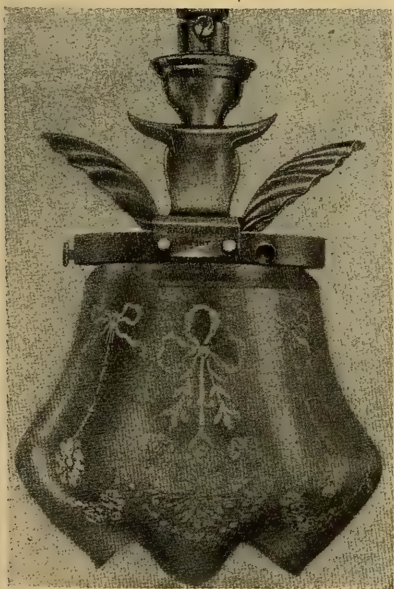


FIG. 1.

The public demand very light fittings for inverted gas burners, and inventive minds are busy making these adaptable to all sorts of positions. The flexible metal tube has worked quite a revolution in the form and shape of all pendent gas fittings. The use of the electric glow lamp has set the fashion of using lights which may be placed at any angle. This portability has not yet been made possible with gas fittings, but we have seen a very admirable pendant, which is illustrated in Fig. 2. This particular pendant is not only adjustable vertically as to its length, but can be placed at any angle, as shown by the dotted lines in the illustration. The name given by the inventor is the "Ideal"; by its use one lamp can be made to illuminate any given point efficiently within an extremely wide area. For example, a 10 ft. pendant will light a working space of 700 square feet. The flexibility and range is obtained by a very ingenious combination of a sliding main tube, and a universal friction head, consisting of two sets of flat-friction plates,

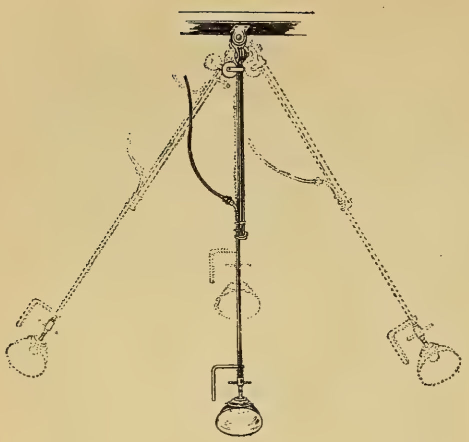


FIG. 2.

the centers, or axes of which are at right angles to each other. The upper set is fixed to the ceiling, or any other support, and a guide tube is attached to the second or lower set. The sliding rod, it will be noticed, carries the burner, which fits comfortably into a concave recess in the guide tube by means of two spring clips. The gas connection between the sliding tube and the gas supply is made by means of a metal flexible tube, which is of such a length that in whatever position or angle the pendant is placed there will always be sufficient "slack." There is no strain on this flexible tube, whether the burner is pulled down to its full length, or shortened to the extreme limit of the guide tube. The weight of the burner in either case is upon the sliding tube, and not the flexible gas supply tube.

It may interest some readers of this magazine to know that in connection with the Gas Testing Department of the City of London, no less than 80,703 meters were tested in the year just reported upon. The size of meters ranged from 500 to 1 light for dry meters, of which the number tested were 79,067, and from 1000 to 3 light for wet meters, of which there were 1636. The Sales of Gas act makes provision for gas meters to be passed as correct that measure not more than 2 per cent. fast or 3 per cent. slow. The report before us states that: Of the fast meters, those under 4 per cent. numbered 763, over 4 per cent., and under 7 per cent., 499; over 7 per cent. and under 10 per cent., 119; over 10 per cent., and under 20 per cent., 29; over 20 per cent., 3; the greatest error found being 25 per cent. Of the slow meters, those under 5 per cent. numbered 493; over 5 per cent. and under 10 per cent., 673; over 10 per cent., and under 20 per cent., 570, and over 20 per cent., 228. It will thus be seen that taking these figures, the consumers generally get the benefit of the meter registering incorrectly. The total number of prepayment, or penny-in-the-slot meters tested was 41,107 more than 50 per cent. of the whole number; of these by far the greater number were three-light meters.

Clustered inverted burners are becoming more general; we illustrate one recently invented by Messrs. Alfred Arculus, lighting engineer, of Birmingham, illustrated in Fig. 3. The invention consists in arranging the parts of the lamp so that the air supply to the air bulb of the burner is effectually prevented from being contaminated by the products of combustion rising from the burners. It will be seen on reference to the diagram that each of the air-inlet bulbs belonging to the burners is contained in a separate compartment (see plan), or part of the top of the lamps, so arranged as to receive, from the outside, air which has not been contaminated. The compartments which contain the air bulbs can be arranged in a variety of ways, so as to render them easily accessible from the outside, both for cleaning and regulating the air, or gas supply.

We cannot better conclude this matter than by drawing attention briefly to the lamps adapted for lighting the grounds of the important exhibition now being held in Edinburgh. Fig. 4 illustrates the large lamp that is in use, which is the invention of the James Keith and Blackman Com-

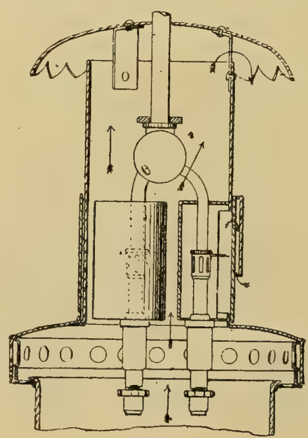


FIG. 3.

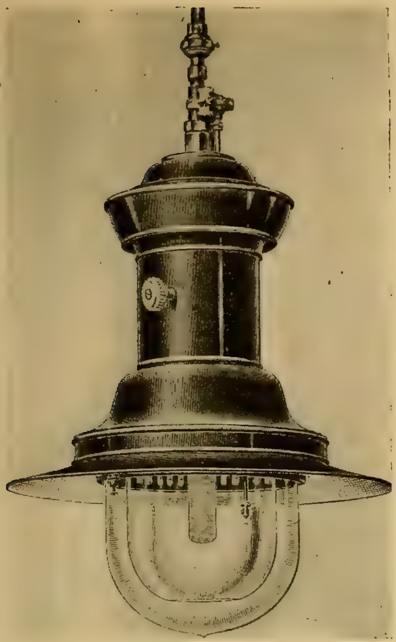


FIG. 4.

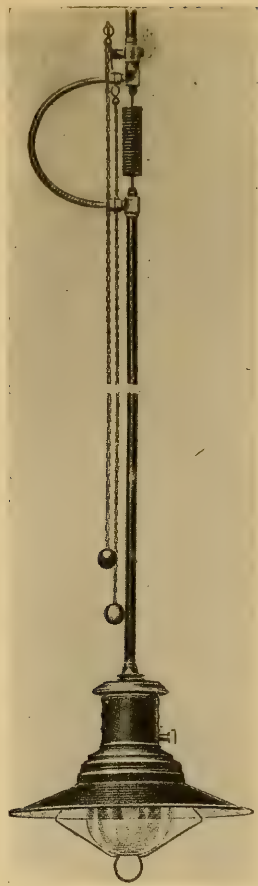


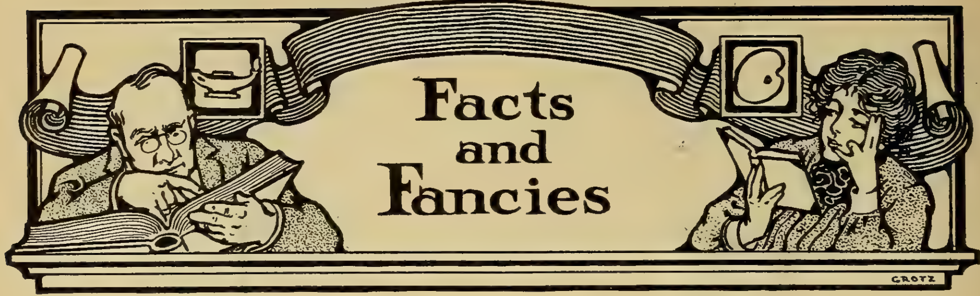
FIG. 5.

pany, lighting engineers of note in this country. The lamp is supplied with gas at a pressure of some 55 in.; moderate heating of the secondary air, higher heating of the primary air, and a final heating of the Bunsen mixture just before it reaches the point of combustion increases the illuminating power from 35 candles to 70 candles. Mr. M. R. Herring, of the Edinburgh and Leith Gas Undertaking, in a test made with the lamps under review, using a 20 to 21 candle gas, secured the astounding illuminating efficiency of 73.6 candles per cubic foot of gas. The test was made with a Simmance-Abady portable photometer, working at about 20 degrees below the horizontal. The lamp, with a consumption of 22.9 cubic feet of gas gave a total illumination of 1685 candles using a single mantle. The mantle shown in the illustration is larger, and in proportion, narrower, than the usual form used for inverted burners; it measures 3⅝ in. long and 1½ in. in diameter. The mantles, we understand, may be put on the burners either in the soft or unburned-off condition, or in the usual collodionized form. We are told that when used in the soft state they shape themselves to the flame with almost mathematical proportions.

In Fig. 5 we show an indoor form of this new lamp, which is practically a replica, on a smaller scale, of the large lamp; in this form the primary air is not heated to so high a temperature for the simple reason that it has not so long to travel over the heated chimney. The indoor form of lamp has a gauze cylinder surrounding the Bunsen inlets, which makes the lamp specially suitable for mills, factories and workshops, and other places where manufacturing or other dust abounds.

CHARLES W. HASTINGS.

LONDON.




# The Psychological Effect of Light

The fact that color vision is capable of producing distinct psychological effects has been recognized to a greater or less extent for a long time. "Like shaking a red rag at a bull," is an expression implying a most powerful excitation to rage and fury. To "feel blue" is another metaphor which is based upon the well-recognized fact that blue light has a depressing mental effect. Literally speaking, one can no more "feel blue" than he can have "a dark brown taste in the mouth," but as familiar figures of speech they show that color may describe other mental states than those strictly pertaining to vision.

The peculiarly exciting effect of red upon the human mind is referred to by Eugene Field, in his inimitable manner, in a poem bearing the expressive title, "Red."

"There's that in red that warmeth the blood,
And quickeneth a man within,
And bringeth to speedy and perfect bud,
The germs of original sin."

"To paint the town red" is still another expression which recognizes the stimulating effect of light rays having a wave length of .00,000,266 inches. Anxiety to "whoop things up," as Field expresses it in another poem, may therefore be simply the result of 395 millions of millions of ether vibrations per second impinging upon the retina of the eye, instead of the use of beverages containing $C_2H_5(OH)$.

Max Nordau, in his much discussed book, "Degeneration," goes into the psychological effect of color to quite an extent, referring particularly to the extensive, and, in his opinion, perverted use of violet by the "impressionist" school of painters, as an evidence of their degeneracy.

Dr. Lillian L. Bentley has been making an extended study of the subject, and has given the results of her investigation in an article contributed to that popular technical periodical, "The Ladies' Home Journal." With her general conclusions there is little ground for disagreement; but some of her reasons for the conclusions appear to be far-fetched. She cites a number of instances illustrating the exc'ting effect upon the nerves of red color vision, which she accounts for by the statement that red is the most powerful of all the colors, that is, that the red waves of light contain the greatest amount of energy. While this might account for undue nervous excitation, the converse of the proposition, namely, that blue and violet are correspondingly depressing by reason of their small amount of energy, would hardly be a logical conclusion. The subject is worthy of serious thought, however, especially in connection with the decoration of living rooms, and particularly those most used by children; also in hospitals and other institutions for the treatment of the sick. The following extracts from Dr. Bentley's article will afford food for reflection:

Often have I seen, in my practice, instances of the effect of red as it is used for decorative purposes in homes.

I remember the case of a woman who had a beautiful lamp. The shade was of a superb green, inlaid with a dark, rich red; at night, when the electric light was turned on, the deep Pompeiian red of the day was transformed, becoming a brilliant scarlet. She did not know the reason, but often said that

this shade, which gave her so much æsthetic pleasure by day, became a positive nerve-irritant in the evening. "Strange," she said, "but I can hardly endure it."

To prevent pitting, smallpox patients are sometimes placed in exclusively red rooms. After varied lengths of time they invariably beg most piteously to be taken out. If they are not soon removed they become delirious and often have convulsions. This test has, of course, for humane reasons, never been carried further, but the experiment, so far as it has been tried, leaves no room for doubt that, if the patients were kept in the room, insanity would be the result. After removal the patients cease their delirious ravings, and show the greatest mental and nervous relief.

Watch an audience at a theatre where a spectacular play is given, and where the members of the ballet are marched on to the stage in solid "battalions" or "phalanxes," representing the different colors. As the greens, shading into olive, the browns, shading into tan and yellow, come on the stage there is a satisfied exclamation of "Isn't that beautiful!" With the blue and the violet comes the suggestion of quiet and calm. When the red appears under its exciting influence the audience will involuntarily and instantly break out into spontaneous applause. It is not that the eye is fonder of red than of green: it is that red has an instantaneous effect upon the nervous system that immediately seeks an outlet and finds it in applause. It is exactly the same effect that red has upon the bull, only the human intelligence comes to the rescue and modifies anger into nervous restlessness and disquietude.

Violet, the color of sadness and grief, is the most depressing of all the colors, and produces the most terrible mental depression and stagnation in persons exposed to its exclusive influence. This fact has been made use of by the Russian autocracy, which has, or had, rooms in one of its places of "retirement" from the world, in which are confined those men of unusually brilliant mental attainments who oppose its government policies. All rays of light, the vibrations of which are slower than those of blue or violet, are excluded from these rooms. In every case the mind of the occupant, once brilliantly alert, becomes so dulled that he is unable to cope with the simplest facts of life.

What is the explanation of all this? one naturally asks. Why is red so stimulating, so exciting, so appealing to our nervous activity?

The reason is this, and I must be a little scientific in explanation, because it is a scientific fact: All colors are produced by vibrations, or what are called oscillations, of rays of light. Rays of light which vibrate less than four hundred and seventy billion times a second, if seen by the eye at all, produce a red sensation. As the oscillations increase in number we see all the shades of orange, yellow, green and blue. Beyond seven hundred and twenty-two billion oscillations a second violet appears, beyond which point the eye cannot appreciate vibrations of light. We call this the end of high vibration, and we pass gradually back to where we were before we saw red—that is, into black.

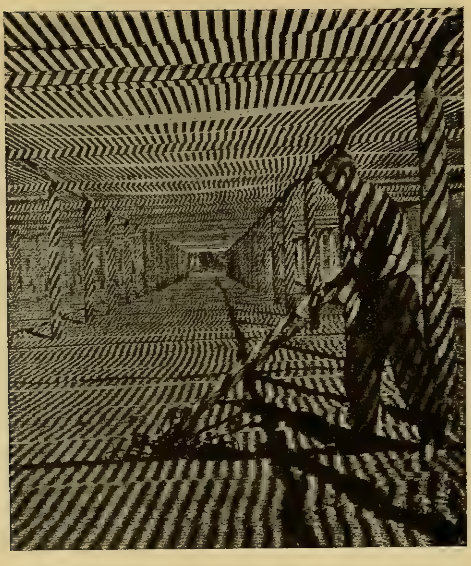
Now, the slower the rays of light move the greater amount of energy light of itself contains—the more rapid the vibration the less energy and the less tax they ask of the eye that sees it. To put it plainer: the more that a color asks of us in the way of energy—the slower it moves, the more powerful it becomes and the greater the strain upon our eyes, our mind and our nerves. The vibrations of light must be tremendously rapid to soften the colors which they make to the eye.

Hence where the vibrations move so slowly as in red, the tremendous power there is in light itself makes too strong an appeal to our nervous system and we cannot endure it. We cannot control our mental or moral basis amid red. We see this illustrated in the prodigal use of red in places where it is desired to stimulate our desires, our passions: as witness the use of red in saloons, in places of gayety and worse. Moral downfall is always illustrated in red, as, for example, in every colored representation of Satan. When any appeal is directed to the barbarous in us, when our baser selves are to be brought into play, there is an invariable use of red, because its power is so great as to be capable of upsetting our mental or moral equilibrium. We cannot endure its power: we lose our temper, we fail to control ourselves. The light has too much energy for us, and our self-control is not equal to its power.

Red is undoubtedly a beautiful, warm color. We need it in many places to help bring brightness and cheer. But it should never be used in quantities—only in spots. A little of it goes a long way. It should never be put in a strong light either by day or by night—it should never be put where the eye must look at it at close range, or associate with it day after day.

## Flaming Arc in Berlin

Only flaming arc and high-efficiency incandescent lamps are used in the business portions of Berlin, and 90 per cent. of the outdoor lighting is now done with flaming arc lamps. Both tantalum and tungsten lamps are used, but the former are seen usually in old fixtures where the lamp cannot be placed vertically.



## What Is It ?

The above illustration, reproduced from the *Scientific American,* appears at first sight to be some sort of picture puzzle or optical delusion. It might, it is true, serve as a test for astigmatism, but this property is wholly incidental. The man in the case is not a convict, but is dressed, as careful examination will show, in regulation shirt-waist suit. The curious effect produced is due entirely to the sharp contrasts of light and shadow produced by strong sunlight falling upon and through an overhead lattice-work. The black bars at the top are the under sides of the strips of the lattice, while the light streaks are the sky seen between them. The spiral stripes of the posts and the parallel stripes on the ground are simply the alternate lights and shades produced by the sunlight falling through the bars above.

## Now You Can Buy Gas in a Bottle

Blaugas, a compressed illuminant which can be taken home in steel bottles and fed into the burners by means of little copper tubes no larger around than ordinary wires, was lately introduced to the Society of Chemical Industry by Prof. William Hallock. He is the dean of the department of physics in Columbia University and has given much attention to illuminating methods.

This new kind of lighting vapor resembles in composition ordinary gas such as the people of New York now use. It was invented by Herman Blau, of Augsburg, Germany. It is made at a somewhat lower temperature than is needed in the retorts in this country, and the product is compressed until it takes liquid form. The turning on of the stopcock of the cylinder in which it is placed causes the fluid to expand into gas, and out it comes like the genie which the gentleman of the Arabian Nights' tale found in the bottle he took from the sea.

It burns with a bright light which compares favorably with electricity in brilliance. Professor Hallock declared, however, that it was more expensive than the ordinary gas of the street mains, which he said was good enough in its way, but "horribly inefficient."

Blaugas is not likely to drive out the gas companies of New York, and the chief chemist of the Consolidated Gas Company sat on a table at the back of the hall and chuckled. Blaugas, however, is a very portable commodity, and it can be taken aboard yachts and "wired" in country houses, and made available very easily on short notice.

Professor Hallock said that it was not affected by temperature changes and could be kept indefinitely.

"In fact," he said, "I do not see any reason why Blaugas could not be willed in cylinders from father to son for generations if it should be necessary to keep it in the family as an heirloom for so long."

He installed several cylinders filled with the new illuminant in the lecture room of the Chemists' Club and turned on a few litres of it for the benefit of the scientists. The tubes which he employed were of finely drawn copper and were only one-sixteenth of an inch in diameter. They were curled about just like electric wires, and at a distance they looked just as though they might be part of some electric machine.

Professor Hallock declared that a ten kilo cylinder of Blaugas, which costs $1.50, would supply a 50 c.p. incandescent burner for four months, provided it was used four hours a day.—*New York Herald.*

CASHIER BOOKKEEPER CONTRACTS ADVERTISING

# Commercial Engineering of Illumination

## Looking Forward


The Lighting Companies that disbanded their New Business Departments last winter should get them in working condition for the fall campaign.

# Extracts from the Commercial Day Program of the N. E. L. A. Convention

**From "The Contract Agent and the Representative."**

### THE SIGN SPECIALIST

The sign specialist works in conjunction with the district representative, and must, at all times, co-operate with him. He can be invaluable to a company, but he must do more than simply sell signs or install outlining. He must see to it that the customer uses his signs and lights and uses them every night for a period of hours. He must not lose sight of the fact that he is selling electricity.

The sign specialist should be an expert in figuring rates, being able to determine cost of operation from the installation, time, and number of hours burning.

The sign specialist should have more or less of the advertising man's alertness and optimism, as the selling of electric signs is in reality one form of advertising.

While the sign specialist does not need to be an artist, he should have a practical knowledge of commercial sign writing. He must know about letter construction and what is considered a good "layout" in a sign. He should post himself thoroughly on every style of electric sign—not only in his own city, but in others as well, in order to answer intelligently any questions regarding same. He must be resourceful, and see to it that every sign he puts out is a work of art and has an individuality. He can keep alive the spirit of friendly competition among merchants in the use of decorative and sign lighting, when ordinarily this class of business would stop just beyond the minimum for sheer lack of originality in designs and because of human tendency to follow beaten paths.

The sign specialist should be able to do his own designing:

*First.* Because no one else can see the sign as he has it in his own mind.

*Second.* Because it saves time, and time is very valuable when talking with a prospective customer.

*Third.* Because he himself is better satisfied and it increases the customer's respect for his ability.

The sign specialist eliminates the possibility of an ordinance restricting the use of signs, by preventing the erection of undesirable, unsightly and detrimental signs, and by supplying individual designs and works of art. He does much to "boost" the city, for he beautifies it after dark. This means growth, for the well-lighted city draws many people from the country towns and other communities.

The sign specialist must broaden his work to include window lighting, outlining of buildings, decorative lighting of streets, and billboard lighting.

One thing the sign specialist should remember is that while the number of his immediate prospects is the difference between those merchants having display lighting and those without it, should he succeed in getting every merchant to use display lighting, his prospects would not be diminished, for the merchants could then be enthused and incited to compete with each other in the magnitude and attractiveness of their lighting displays.

### ILLUMINATING ENGINEERING.

The enormously increased use of artificial light, the greater complexity in the condition of modern life, and the increasing diversity in light sources, have together made the general subject of artificial illumination an important branch of the commercial department of a central station. This field has created the new specialist—the illuminating engineer.

It is the business of this specialist to determine just what kind of light and illumination is the best for every purpose and to so arrange the lighting system that the best possible results will be obtained at the minimum of cost. It is a very common thing for the consumer to find fault with the electric light—its quality, its intensity, and so forth—when it is not the fault of the electric light, but of the manner in which it is used, and this gives rise to the problems of illuminating engineering.

The field of the illuminating engineer is a large and important one, often overlooked, but none the less valuable. Consumers often become dissatisfied with high bills and poor illumination and are willing to go to extremes, such as installing inferior service, in order to economize. Here it is that the specialist is invaluable to the central station; he can advise the proper use of light and secure better illumination. The consumer appreciates such service most highly and he immediately enters the employ of the company as a booster.

Many companies are not financially able to employ the services of an illuminating engineer, but in these days, when books and

periodicals on this subject are within the reach of every one, there is nothing to prevent any representative becoming proficient along the lines of illuminating engineering.

### From "Evolution of New Business Building"

EXAMPLES OF CENTRAL STATIONS THAT HAVE CONTINUED METHODS DURING DEPRESSION

A letter of inquiry addressed to the central stations that had for some time carried an aggressive new-business organization brought the information that all the stations that continued their departments throughout the depression not only held their previous revenues, but made generous increases.

These central-station men express the opinion that they have by this policy insured valuable development for the future, which would not have been the case under a policy of retrenchment. Those who were forced to discontinue their new-business work seem to have been less fortunate.

At the first shadows thrown over the country by the financial stringency from which we are just recovering, many central stations, forgetting exactly what had been gained by them through a progressive commercial department, withdrew their selling forces from the field of their activity and in this way not only lost many and valuable customers immediately, but imperilled their present business.

The men who created the first new-business departments recognized the fact that their advantage lay quite as much in retaining what business was connected as in getting new consumers connected to their lines. These men, probably through experience, realized that with a public-service corporation the greatest danger lay in separating itself too far from the people, hence they filled the commonly-existing gap with representatives skilled not only in new-business getting, but in making friends. As a normal and logical consequence, a great deal of the company's business was subject to the individuality of the representatives, and when this powerful factor was discharged, the customer, reacting as by the example of the lighting company, withdrew some of his expenses, for the first item to be cut by the smaller merchant is invariably electricity.

So large an institution as the Commonwealth Edison Company, as well as central stations in towns of 5,000 population, profited by maintaining their new-business departments.

Geographical conditions do not appear to affect the question.

#### The Scranton Electric Co., Scranton, Pa.

A conspicuous example of quick and effective results under similar conditions is that of the Scranton Electric Company. Carrying a new-business force of 12 men, it not only used the representatives during the depression, but kept up its newspaper advertising, also indirect advertising, and, above all, its nerve. The officers probably figured that keeping up appearances was about the best asset. The City and its suburban neighbors were redivided into districts, and new energy was infused into the new-business force by a grant of wider authority. The representatives were practically made managers of their several districts and given to understand that the officers would look to them, not only for results in additional business, but for maintaining the efficiency of the present business as well. As a perfectly natural consequence these representatives looked deeper into the affairs and conditions of their districts, became more familiar with them, and produced new business far in excess of all expectations.

The advertising was specialized, and the copy was made to talk hard, cold sense. As a consequence, when an advertisement bearing the signature of the Scranton Electric Company was read, it carried with it the perfect assurance that it was true. The result of this specializing and clean-cut work, added to the increased efficiency of the representatives, was the increase of new-business returns to a figure scarcely credible and reduction to an absurbly small fraction of the cut-off order issued to the distribution department.

Incident to the Scranton campaign—when the property was acquired by its present owners a year ago—the president publicly assured the citizens that the policy of the new-business campaign would inspire a civic pride which would revolutionize the general appearance of the business districts, not only from a lighting standpoint, but in other features.

The prediction has been more than fulfilled. Scores of new store fronts have been installed within the past year, and the city has established a natural reputation for progressiveness.

#### The Thornapple Gas & Electric Co., Hastings, Mich.

For the five months ending April 1, 1908, we have closed power contracts with 21 customers, installing therefor 48 motors aggregating 414 horse-power, the increase in connected horse-power for the period named being 160 per cent. In doing this, we have displaced six steam engines ranging from 6 to 150 horse-power, eight gasolene engines

ranging from 2 to 15 horse-power and one 15-hp water wheel. One of these contracts will require us to arrange for the delivery of 200 additional horse-power by July 1, 1908, and by the time this is in your hands we shall have closed another contract for 80 horse-power.

Owing to the change in selling basis, we have not tried to push spectacular or sign lighting, but have devoted our energies to the pushing of residence lighting and power. The present outlook is that this will be our policy for the balance of the year, and the indications are that our power load will show not far from 300 per cent increase for the year.

### The Mahoning & Shenango Railway & Light Co., Youngstown, O.

At the start, the wisdom of our policy in not disbanding our sales force seemed questionable, but the results in gross receipts during the months of November and December last indicates that all three of our companies did a larger business than in any previous months in their history. Our reconstructed sales department practically took on no new business during this period, but turned the tide from impending loss to certain profit by holding and increasing the business we already had.

### A Strong Plea for the Upkeep of Commercial Departments and Advertising

The personal weight which the commercial department holds with its purchasing consumer is a valuable asset in obtaining business that could not be secured through any other medium. Furthermore, a competent corps of solicitors is something that can not be created in a day. Can we afford to let the result of our past energy begin to decay? Now is the time for action. Why desert our fortifications only to let others enter to destroy that which has taken time and money to build up, by introducing inferior lighting systems and appliances that can be operated with products other than electrictiy? How many merchants are leaving their stores and windows in darkness on account of the depression? Is there not all the more need for making the stores as cheerful and confidence-inspiring as possible? How can these wonderful results be obtained without the commercial-engineering department? Is it not the most important department in the electric business?

There is no surer way to produce and further hard times than to cease the effort to secure additional business. The opportunity to obtain additional business with the least investment is greater at this time than ever before, from the fact that the demand already created gives us a better chance to place additional equipment than ever before, but to accomplish this requires skilful planning and personal solicitation.

The returns from the expense of maintaining the new-business department and keeping solicitors in the field are amply profitable, due to the fact that during hard times so many cheap systems of lighting are introduced to the public for the purpose of bringing about economy. If the district is left entirely to the mercy of your competitor, these so-called systems of lighting, such as gasolene, acetylene and improved oil lamps, will naturally show a marked inroad into the company's business, and are hard to remove after the party has invested his money in them.

During panicky, or any other times, there are always good opportunities for securing additional business along the old line. For any company that will follow a liberal policy, employing good solicitors, backing them with a good system and a liberal policy to the public, there is no reason why the new-business department can not be made the most profitable of all the departments the company supports.

In fact, no company can expect to progress that does not spend a certain percentage of its income for the purpose of securing new business.

### From "Creating Demands"

The man who undertakes a sensible commercial campaign gets what he goes after. If he determines to sell a thousand signs he sells them. If he goes after a thousand horse-power he gets it. The only failures are those who fuss around trying to sell a single small motor or an insignificant sign. Big ideas, common sense, courage—these are the qualifications of the creative business man.

# Illuminating Engineering as a Commercial Factor

By Van Rensselaer Lansingh.

*A Paper Read at the N. E. L. A. Convention.*

When illuminating engineering was being developed in this country as both a science and an art, little or no recognition was given to it, it being felt that there was slight need for such art, and whatever was necessary along these lines could be attended to easily by an electrical engineer.

With the introduction of new lamps and new shades, however, the pendulum swung rapidly to the other side and perhaps too much attention was given to it. The impression grew that illuminating engineering was such an exact science that it required highly-trained men to properly handle or even comprehend it. In the case of complex installations this is probably true, but in nine cases out of ten of those with which the central station manager has to deal, all that is necessary is some of the fundamental principles of illuminating engineering, with a good deal of sound sense. This is now being generally recognized throughout the country, and the central-station manager or head of new business department is endeavoring to train his men so that they can design ordinary lighting installations satisfactorily. That this movement is not only widespread, but is also of great benefit to the central station it is the purpose of this paper to show, the paper being a compilation of some of the results that have been accomplished already by a number of central-station managers throughout the country.

It is a maxim in the lighting field to-day that "a well-satisfied customer is the best advertisement" a central station can have. This has come to be a truism; so much so that in many cases concrete examples or practical applications are entirely overlooked. There are two ways, however, in which this much-worn phrase is proved true, resulting in actual benefit to the central station:

First, by giving the customer the maximum amount of illumination for the lowest expenditure of money possible, a sentiment is created in a community which will successfully resist the efforts of competitors to break in on what should be natural monopoly, and at the same time still the oft-heard cry of municipal ownership.

Second, and perhaps more important, by giving to a customer satisfactory illumination at a reasonable figure the central station will enjoy longer burning hours. This will tend to raise the valley load. There will be an increased use of electric light, which in itself must react and bring more customers on circuit.

The writer has in mind a concrete example of these very facts: A New England city of about 7000 population had adopted up-to-date, progressive methods and was making very satisfactory progress in changing the sentiment of the town from direct antagonism, which had formerly been experienced, to a favorable attitude. This policy had been carried out largely through modern ideas in regard to illumination and the use of correct new lamps in accordance with illuminating engineering principles. A change in management shifted this policy, with the result that the talk of a competing company has not only been revived, but its organization has actually been undertaken. This is simply a straw that shows how the wind blows, but it points out the absolute necessity for the central station to take into account the force of public opinion, and to endeavor to direct the same into channels mutually satisfactory rather than mutually antagonistic.

Many central-station managers have the idea that illuminating engineering is too complex and too large a problem for the ordinary solicitor to handle. This is true of advanced problems in illuminating engineering in the same measure as it is true in electrical engineering; but, just as simple problems in electrical engineering can be handled by the average intelligent solicitor, so in illuminating engineering nine problems out of ten can be handled by any ordinary solicitor who has received a certain amount of proper training. A technical education is not necessary. All that is required is a small amount of study and a large amount of observation and good common sense. Thus, the solicitor must know:

(a) Where outlets should be placed.

(b) What sort of lamps give certain results.

(c) What types of globes, reflectors or shades should be used to secure the desired distribution of light.

(d) What size of lamp to use.

(e) How high they should be placed.

These points require no highly developed technical education, but, as above stated, simply a thorough understanding of the fundamental principles of good illumination—illumination, understand, not illuminating engineering. If a solicitor is properly trained along these fundamental lines, he can, without much difficulty and with great satisfac-

tion to both the customer and himself, design the lighting for the ordinary house, the ordinary store, and the ordinary small auditorium or hall. In cases of more complex installations, such as theatres, churches, and so forth, it will be desirable in many cases to consult some practicing illuminating engineer; although many of the larger central stations are adding such a man to their regular force.

It is not the object of this paper to tell in detail the process of acquiring the necessary knowledge, but simply to show how important a commercial factor good illumination is, as proven by the experiences of central-station men from different parts of the country. The writer is much indebted to the several gentlemen whose names are given here for the very valuable information and support they have rendered in the preparation of this paper.

### Advisability of Good Illumination.

The old idea, and one still in vogue in many places, is that when the central station runs its lines to the customer's premises it is then up to the customer to make whatever use he can of the electricity so furnished. This idea that the responsibility of the central station ceases at the doors of the customer's house is now being rapidly supplanted by the new idea that the central station must see that the customer gets the very best appliances, and uses electric light in such a way as to give him the most satisfaction at the least cost. Thus we have the statement of Mr. Richard E. Brown, contract agent for the Geneva-Seneca Electric Company:

"My experience has been that the most successful lighting companies commercially were those adopting the latest lighting units and applying illuminating engineering principles to their customers' lighting systems. Proper distribution system and economical units will do more to boost the sale of juice than a dozen solicitors lacking in knowledge of the-most-light-for-the-least-money idea."

Mr. J. E. Davidson, of the Montpelier Electric Light Company, states: "I think we can do more toward knocking out and keeping away gas competition by scientific laying out of lighting, and making satisfied customers, thus increasing our revenue, than in any other way."

Mr. Joseph D. Israel, of the Philadelphia Electric Company, states: "With the advent of the high-efficiency lamps and the new type filaments, together with the introduction of scientific shades, we feel that advanced illuminating engineering methods are well worthy of the attention of the central station, as work along such lines assists greatly in diminishing the number of cutoffs and assists in securing new business and in displacing gas and other forms of illumination."

Mr. Laurence D. Jones, of the Consolidated Gas, Electric Light and Power Company of Baltimore, writes as follows: "In our estimation it is very important that the consumer of electric current should be provided with the properly designed equipment in order to secure the maximum value from current used. I believe that the importance of proper distribution of lighting is such that the large central-station company should employ a lighting expert capable of handling complicated situations, and that to him should be referred all matters of such magnitude as to justify special attention."

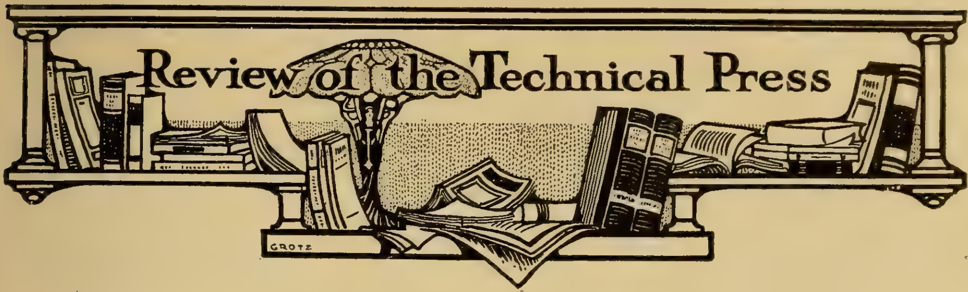
Mr. Brown, above quoted, expresses the same idea in a slightly different form: "A majority of the complaints received by central stations arise from two causes: Excessive bills and poor light. These complaints can, in nearly all cases, be traced directly to one cause—lack of knowledge on the part of the man planning the lighting system, and consequent large current consumption in proportion to the illumination obtained. Such conditions can be readily remedied by the central-station man making a study of the elementary principles of illuminating engineering and applying his knowledge to the cases brought to his notice."

Mr. Alex. Campbell, of the New London Gas and Electric Company, sums the situation up as follows: "A wide and broad policy seems to require that the lighting companies should actively advocate the general use of better methods of illumination, with the conviction that by so doing both they and their customers will be benefited."

Mr. F. H. Golding states: "In meeting sharp gas competition, where the cost of service is a factor, a careful study of conditions and the understanding of the relative effectiveness of various classes of illuminants is essential to the electric light solicitor, just as a thorough knowledge of the commodity he has to offer is necessary to a salesman in any other line."

Mr. E. E. Larrabee, who is manager of the progressive central station at Bennington, Vt., states: "I personally believe that any company, even if it be a combined gas and electric company, makes a very serious mistake in trying to keep customers from using the higher efficiency lamps, and while it may seem a little strange to others that we advocate giving the customer lamps that reduce the current consumption and at the same time time increase the illumination, we believe that it is the best business policy to do so; that we get home advertisement and more new business, and consequently more money, by so doing than we ever could get by knocking the high efficiency lamps or refusing to handle them."

*To be continued.*




# American Items

## New Books.

THE AMERICAN PRACTICE OF GAS PIPING AND GAS LIGHTING IN BUILDINGS; by Wm. Paul Gerhard, C. E. 293 pages and index. (Not illustrated). McGraw Publishing Co., New York. $3.00 net.

The scope of the book is very tersely put by the author in the preface:

"In preparing this book my object was not to treat of the various processes of manufacture and distribution of illuminating gas, nor to discuss the lighting of public streets, alleys, parks and squares.

"It should be distinctly understood by the reader that I take up the subject of gas installation and gas utilization practically at the point where it reaches the consumers' premises. I endeavor to explain how gas-fitting should be done so that gas may be advantageously employed in the illumination of the interior of buildings. Incidentally, other uses of gas are mentioned and their advantages pointed out. * * "The book is intended chiefly for the use and enlightenment of the gas consumer and the householder."

Even this brief extract from the preface shows the unusually matter-of-fact, clear and concise style of the writer, which forms one of the chief merits of the book. It is entirely free from those technicalities which are either unnecessary or unintelligible to the ordinary user of gas.

The first three chapters deal respectively with: "Prejudices against the Use of Gas," "Popular Fallacies about Gas," and "Advantages of Gas as an Illuminant."

The next eight chapters deal with questions of piping and testing for all the commercial forms of gas. Then follow eight chapters which deal with gas light illumination, among which are included a chapter on "Pressure Regulation" and a chapter on "Gas Meters and Gas-Meter Stories," which deal with a considerable number of typical complaints from householders, giving explanations of their true causes.

The six remaining chapters deal with Accidents, and Danger to Health, including leakage of gas,—Historical Notes, and a very complete Bibliography of Gas Lighting.

As would be expected from a writer having as broad a conception and intimate a knowledge of the subject as Mr. Gerhard, the science of Illuminating Engineering has been fully recognized: "The art of illumination is practically a new science and it is only recently that professional men have taken up the subject from a scientific as well as practical point of view. A large, untrodden field is open to the new profession of the illuminating engineer."

The book throughout is thoroughly practical; it contains no dead wood or padding of any kind, gives such information as will be of positive value to the householder or gas-fitter, and is especially valuable for illuminating engineers, giving just the data and explanations in regard to the mechanical part of gas-lighting that they should know, without going into unnecessary engineering details.

THE SAN FRANCISCO ILLUMINATION; *Western Electrician,* June 6.

An illustrated article describing the special illumination of the city on the occasion of the visit of the Atlantic fleet.

LIGHT CHEAPENED BY NEW GAS, by Dr. Alfred Gradenwitz; *Technical World Magazine,* May.

Describes the method of making illuminating gas from coke and oil by the Dannert process, which has recently been brought out in Germany.

TEXTILE MILL ILLUMINATION, by A. S. Hubbard; *Textile Manufacturers' Journal,* May 9.

Treats particularly of the use of the mercury vapor lamp in textile mill illumination, illustrating and describing some particular cases.

THE QUALITY OF ARTIFICIAL LIGHT, editorial, *Electrical Review,* May 23.

A review of Dr. Nichols' paper read before the New York section of the Illuminating Engineering Society.

HOW TO REDUCE GAS BILLS, by R. A. Field; *Light,* May.

The report of an address by Mr. Field to the employees of the Rome Gas, Electric Light and Power Company.

Mr. Field said:

"There are many strange things in the world of business, one of them is the peculiar relationship existing between a lighting company as the producer and the public as consumers, and in this connection it might be of interest to briefly outline the proper way of finding out how much and what kind of light it will take to satisfactorily illuminate any room or enclosed area.

"It may also be of benefit to bring out the care with which every possible economy is worked out in the manufacture and distribution of both gas and electricity as contrasted with the reckless extravagance and waste which usually occurs on the consumer's premises after he has purchased the products, taken them out of the producer's hands, and proceeds to turn them into illumination after ideas of his own.

"Think what it would mean if it were possible to reduce the expense of manufacturing and distributing our products to half of what it now costs. It would mean a revolution in the lighting business, yet it is a conservative statement that the majority of those using gas or electricity for lighting could readily reduce their monthly bills 25 per cent. and still get from 25 to 50 per cent. more illumination than they now have."

DOWNWARD VS. HORIZONTAL ILLUMINATION, editorial, *The Electrical Age,* June.

A discussion of the article on the same subject which appeared in the previous issue.

SOMETHING ABOUT THE FOUR THOUSAND ELECTRIC SIGNS OF CHICAGO; *Western Electrician,* May 23.

Illustrated article describing some of the most novel and conspicuous electric signs installed in the city.

THE LIGHT AND THE BURGLAR, by "R"; *American Gas Light Journal,* May 25.

A short article seeking to prove that all-night lights are a better burglar protection than most mechanical devices.

HOW THE ELECTRIC ARC PRODUCES LIGHT; *Southwestern Electrician.*

A short, popular description of the arc lamp.

INTRODUCTION OF THE TUNGSTEN LAMP, editorial, *Electrical World,* June 6.

DAYLIGHT AND ARTIFICIAL LIGHT, editorial, *Electrical World,* June 6.

LIGHTING OF THE HOTEL ALBANY AND COLLEGE INN, NEW YORK CITY, by H. Thurston Owens; *Electrical World,* June 6.

A detailed account with illustrations of the lighting installation of this hotel.

THE INVASION OF NEW YORK CITY BY DARKNESS; *Record and Guide,* June 6.

Contains striking illustrations showing how the increased height of office buildings, especially in the older section, or "financial district," of New York is adding to the seriousness of the problem of securing light and ventilation in the offices and interiors of the buildings.

THE PAST AND PRESENT OF INCANDESCENT LIGHTING, by Edward R. Knowles; *Electrocraft,* June.

The first installment of a serial article; deals particularly with the invention of the incandescent electric lamp, and discusses the relative merits of the claims of Edison and Sawyer as inventors.

# Foreign Items

COMPILED BY J. S. DOW.

Two lectures dealing with illumination from the standpoint of those responsible for the lighting of streets and public buildings were delivered at the recent Municipal Exhibition, held in London from May 1 to May 12, by Mr. Leon Gaster, editor of THE ILLUMINATING ENGINEER (London), and Mr. J. S. Dow.

Mr. Gaster dealt specially with the importance of good illumination in schools and quoted opinions of various authorities in support of his suggestions; the importance of the matter could be judged from the fact that there were nearly a million children attending school in London alone. In this connection Mr. Gaster suggested that the inspection of the general health of school-children, including examination of eyesight, and now undertaken authoritatively by the Board of Education for the first time this year, should be extended to the study of the conditions of illumination which are admitted to be at least partially responsible for defects in vision, etc.

The lecturer then passed on to factory lighting and library lighting, and finally to the subject of street-illumination, which, he said, was of special interest to municipalities. He impressed upon his hearers the necessity for closer co-operation in these matters, and suggested the formation of a central testing establishment for the benefit of all participating, where tests could be undertaken, on a sufficiently large scale, by recognized and impartial experts. He added that he should like to see included a museum where the latest types of illuminants and instruments for the measurement of illumination might be on view and easily accessible to those interested in the matter. At present developments took place so rapidly that some such opportunity was badly needed in order that engineers might keep abreast with recent progress.

Mr. Dow's lecture was more particularly devoted to actual methods of measuring light and illumination and consisted mainly in a popular resumé of recent progress in the subject. He impressed on those present that photometry was no longer a merely scientific interest, but had reached a thoroughly practical stage, and supported the suggestion of a testing establishment on the lines advocated by Mr. Gaster. He also spoke of the good work that had already resulted from international co-operation, and pleaded for a freer interchange of ideas between those interested in different methods of lighting in England. These two lectures are reported in recent numbers of the *Journal of Gas-lighting* (May 12 and 19).

At the conclusion of the lectures, a series of demonstrations of the action of different types of photometers and illuminometers was given, instruments having been kindly sent for the purpose by makers not only in England, but also in Germany and the United States.

Niemann and Du Bois (*J.f.G.*, April 18) contribute a continuation of their recent historical study of illumination. The present instalment deals with methods of lighting in the Middle Ages, and is illustrated by means of a number of drawings and photographs showing the nature of the huge fixtures used at that time for the lighting of large halls and churches, &c.

Weinbeer (*Elek. Anz.*, April 21) continues his previously published series of articles on the production of uniform illumination by means of various types of artificial illuminants. These he divides into four main classes, according to the nature of their polar curves of distribution of light, and, in the article to which reference is now made, illustrates his previously determined results by several concrete examples.

Schilling (*J.fG.*, April 18) gives some examples of the degree of illumination found necessary in the *Technische Hochschüle* at Munich. Originally 40 lux was provided, but complaints of the poverty of illumination caused a value of 80 lux to be afterwards specified. Ultimately it was found desirable to increase this value to about 112 to 115 lux; under these conditions even one of the lamps failing to work entirely would only reduce the illumination to about 70 lux.

The author shows that the number of lamps required to produce such an illumination is in fair agreement with the computed value suggested by his own tables.

Schuchardt (*J.f.G.*, May 2) describes the photometrical laboratory of Messrs. Ehrich and Graetz.

The *Sweizerische Elektrotechnische Zeitschrift* (April 25) describes a new portable and enclosed form of photometer produced by Messrs. Siemens and Halske. In this instrument the "angle-mirror" method, sanctioned by the Verband Deutscher Elektrotechniker, is used for the determination of mean horizontal candle-power. One point of interest is the use of a special form of "grease-spot" screen composed of two frosted glass plates, between which is placed a silvered spot. Some results, obtained by different observers, are given, the maximum discrepancy between the individual readings of all observers amounting to about 5 per cent.

### Electric Lighting.

The number of papers dealing with the metallic filament lamps is this month greater than ever. Chief among these may be mentioned the paper by Mr. Hirst before the Institution of Electrical Engineers in London on May 21st. The author dealt mainly with the tungsten lamps, though he prefaced his subject proper with a short historical introduction. Of the many evisting processes for the manufacture of tungsten filaments, he contended that only those of the Just and Hanaman and the Deutsche Gasglühlicht Aktiengesellschaft have led to the manufacture of really commercially successful lamps. The author next describes the exact method of manufacture of osram and Just-Wolfram lamps, and alludes to the curious behaviour of the metallic filament lamp in apparently radiating only 87 per cent. of the energy per unit surface that the carbon filament lamp does, and yet giving 275 per cent. more light; this is to be ascribed to some form of selective radiation. Reference is made to the behaviour of osram lamps in actual practice and their probable influence on the lighting industry; some interesting particulars of the loss in small transformers are given.

There are also a number of articles dealing with the more technical side of the question. The *Zeitschrift für Beleuchtungswesen* continues a very comprehensive review of recent patents on the subject, and also contains a more popular article, in which the writer points out the tendency in all kinds of electric lighting to adopt metallic conductors in place of carbon; this is exemplified by the flame arcs, the metallic filament lamps, and the mercury vapour arc.

Duschnitz (*Elek. Anz.*, April 30, May 14) continues his valuable résumé of patents bearing on the details of manufacture, such as the various devices for the attachment of the filaments to the leading in wires.

Lottermoser (*Chem. Zeitung*, No. 25, 25, 3, 1908, also *Elek. u. Masch.*, April 19) reviews the work of the earlier students of colloidal processes — Bredig, Billitzer, Wedekind, &c., and describes the modern methods of producing metals in a colloidal state, as applied to the manufacture of the Kuzel lamps.

Vollhardt (*J.f.G.*, May 20) describes the most recent form of Carbone high-pressure arc. The general advantages of the lamp—its efficiency and the resemblance of its spectrum to daylight, &c., are pointed out, and the results of some recent tests at Charlottenburg given. The chief point of interest, however, is the fact that it seems to be possible to secure, with inclined carbons, a pressure of more than 80 to 90 volts across the arc.

### Gaslighting, Etc.

The most interesting event in gas-lighting during the past month has been the publication of the tests by Mr. Herring of the lighting of the National Scottish Exhibition, including those on the new Keith high-pressure lamp. According to these tests, which receive retailed comment in the *Gas World* and the *Journal of Gas-lighting*, it is now possible, in the Keith lamp, to secure the exceedingly high efficiency of from 60 to 70 candle-power per cubic foot of gas. Yet the result seems to have been achieved without the introduction of any very novel device, and seems to be attributable merely to the exceptionally perfect conditions secured by the combined effects of high-pressure and heating the combustible mixture. The mantle used is also exceptionally long and narrow, the length being given as 3⅝ in. and the width as 1½ in. in the case of a 1,500

candle-power lamp. Four of these lamps are now erected in Kingsway, London.

Among other articles we may mention the review of existing patents on inverted burners and mantles to be found in the *Zeitscrift für Beleuchtungswesen* (May 10).

A. Granjon (*Rev. des Eclairages,* May 15) discusses the value of different combustibles as a means of rendering mantles, &c., incandescent. He points out the distinction between the heat of combustion and flame-temperature. The former is a constant quantity for the same combustible; the latter, on the other hand, depends upon the exact conditions of use. Thus acetylene yield about 14,000 calories, but its flame-temperature may vary from 2,500 to 4,000 degrees, according to the burner used and other conditions. Acetylene, he thinks, rightly used, may be very valuable for this purpose.

The *Zeitschrift für Bleuchtungswesen* (May 20) contains a discussion of the relative merits of high-pressure gas systems and systems in which the air and gas in the burner are brought into intimate mixture by being churned together or other mechanical means. Our only object in either case is to enable the gas to get as much contact with the air in which it burns so as to cause it to burn quickly and reach a high flame-temperature; for it is on the value of this temperature that the efficiency of an incandescent solid mainly depends. We may accomplish this result by injecting gas at a high pressure. In practice pressures greater than about 1-10 to 1-5 of an atmosphere are rarely used. In the Salzenburg lamp. it is true, as high a pressure as 1.1 atmospheres was actually used; but this lamp does not seem to have found its way into practical use in this form as yet. The high-pressure method is open to various objections, however. For instance, the supply of high pressure gas demands special pipes, and when two systems for street-lighting and house-lighting respectively exists, two sets of mains may be necessary.

For this and other reasons the author prefers the method of causing a mixture of gas and air by some arrangement not involving the supply of high-pressure gas, and mentions in this connection a series of tests made upon the Pharos light.

Lastly, mention must be made of a recent article by Schäfer (*J.f.G.,* April 25) dealing with the illumination of interiors by means of gas. The author lays stress upon the necessity for studying the distribution of light in such cases, and the value of the inverted lamps, which may be arranged to throw the light just where it is needed.

The article is accompanied by a series of photographs showing the fixtures employed and their position for the illumination of various types of rooms.

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## Luminous Signs for the Experiment Table in Darkened Lecture Theatres

By H. J. Reiff.

(Abstracted from the *Physikalische Zeitschrift,* November 1, 1907.

There are many lecture experiments, such as the exhibition of vacuum tube discharges, etc., which have to be conducted in a darkened room, in order to be seen properly. In such cases an ordinary source of light, however well screened, is more or less unsatisfactory, for, even when directed away from the audience, and too subdued to interfere with the experiment, it is apt to dazzle the eyes of the lecturer.

For the purpose of revealing the situation of the various pieces of apparatus, the author has found the following device very convenient: He arranges small luminous signs, which are cut out of tin and coated with luminous paint, and are attached to or placed beside these pieces of apparatus, serving to indicate any feature which the lecturer desires to bear in mind. These signs can be arranged so as to be invisible to the audience by merely turning them with the coated face toward the lecturer; yet their brilliancy is so subdued that they do not produce any impression of dazzle. The signs frequently take the form of letters: they are also very useful for the purpose of indicating the polarity of mains, terminals, etc.

Although, as stated above, it is usually desirable to arrange these devices so as to be visible to the lecturer only, it is occasionally convenient to use them in another way. In experiments in which the gaze of the audience has to be riveted for a long time in a certain direction, awaiting the appearance of some phenomenon, there is a danger that the effect may be missed, owing to the direction of view being gradually altered. It is not easy to maintain one's direction of vision in the dark. The attention of the audience may therefore be focused in the desired direction by the use of a luminous sign. Such a sign is easily visible at a considerable distance in a darkened room, yet there is no danger of the eyes of the observers being dazzled or confused by it.

# Miscellaneous News

BUFFALO, N. Y.—Mayor Adam to-day communicated to the aldermen his veto of resolutions passed noticing the council's intention to extend the lamp district. He says a notice of intention is unnecessary under existing conditions, which put all lighting charges on the general fund. Continuing his communication read:

"Besides, there is no contract with the company and it cannot be required to make extensions. I am not averse to the streets being lighted, and would advise that an experiment be made by requesting the Welsbach Street Lighting Company to install a few of the independent gasoline lamps."

The mayor also vetoed the change of name of Herman street to West Parade avenue because residents object.

CHICAGO, ILL.—Seeking to improve the illumination of the streets of this city, Mayor Alan C. Fobes and Commissioner of Public Safety Harlow C. Clark completed arrangements yesterday for the adoption of a new type of arc lamp here.

The light to be adopted is a new type of magnetite arc lamp and is similar to those now used in the downtown district of the city, except that it has a far greater illuminating power.

FITCHBURG, MASS.—The adoption of gas exclusively for street lighting purposes will, it is understood, be recommended in a report to the Boston Finance Commission by G. U. Crocker, one of the members of that body, who has just returned from a six weeks' trip abroad in the interests of the street lighting system. He says that Boston is living in a dark age in the matter of street illumination.

In discussing his trip, Commissioner Crocker said yesterday:

"The city is living in the dark ages compared with many of the European cities when street lighting is taken into consideration. I discovered that gas is being used almost exclusively in London, Paris and Berlin. The city of Berlin is the best lighted. It leads all others in that respect. The system used is high pressure gas with the inverted mantles. For brilliancy, nothing can be compared to the gas system. It is considerably ahead of electricity, in my opinion."

GRAND RAPIDS, MICH.—When the City Plan Commission proposed to one of the local business men's associations that the present method of lighting our business streets with projecting electric light signs be modified and a system of lights beautiful in themselves be substituted the idea was fairly new. And like most new ideas it was received with caution. But even then the Canal street merchants were considering their arches and the gas company had begun its demonstration on Monroe street.

Since then other cities which had also been considering the profit to be made through rendering their business streets beautiful have been putting their thoughts into concrete form. Milwaukee has abolished all projecting signs on its two principal business thoroughfares and to-day the Greater Milwaukee association is holding a meeting to decide upon the kind of lights which shall be substituted. The probable result is a report in favor of affixing clusters of electric lamps to the top of every trolley pole. In doing this Milwaukee would be following the example of St. Paul which plumes itself upon its Way of Light that has taken the place of the old haphazard patchwork of individual projecting signs.

Meantime Des Moines has adopted an even more artistic scheme. Des Moines has gone to New York for the design of its lamps and has taken one approved by the art commission of that city. This consists of a handsome standard surmounted by a cluster of five lights each of 250 candle-power. The cost of each of these clusters installed will be $100. This and the cost of maintenance are to be divided among the tenants of the property along the street. Six clusters, three on each side of the street, are to be provided for each block. In St. Paul the expense is pro-

vided for in the same way and a similar plan will be adopted in Milwaukee.

NEW YORK, N. Y.—At the investigation of the electric lighting companies, representatives of the New York Edison, the United Electric and Power and the Brooklyn Edison companies announced that they were preparing to put into operation immediately a scheme which would reduce the cost of electric lighting to the consumer by 25 to 50 per cent. The companies propose to cut down the bills by introducing a new incandescent lamp known as the tungsten and tantalum lamp.

SAN FRANCISCO, CAL.—The Permanent downtown association of merchants, property owners and other business men in the triangular district bounded by Sutter, Powell and Market streets has presented to the Board of Supervisors a plan for lighting the retail section of the downtown district. This association, through a competitive test among the leading architects, has secured a handsome design of pole which will adorn the streets in the daytime and furnish a brilliant light in the evening. The plan provides for 160 poles, averaging eight poles to long blocks and three to short blocks. The Board of Supervisors has accepted the plan and the city will furnish the electric current for lighting.

Los Angeles, San José and other Coast cities have adopted lighting systems on similar lines. but the new San Francisco will have a lighting system superior to any. Electrical experts have devised a plan for procuring the greatest amount of light possible for the amount of current allowed by the city.

SCRANTON, PA.—It has ben decided by County Commissioners Durkin and Burschel to have the court house lighted with electricity on the exterior, so as to give the square the appearance worthy of it.

The commissioners met this morning with Duncan T. Campbell, of the electric light company, and closed the arrangements, which call for about 2,000 bulbs to be placed around the four sides and so located as to make an artistic design.

ST. LOUIS, MO.—The Union Electric Light and Power Company has dropped a suit it brought against the William H. O'Brien Printing Company, of 1311 Chestnut street, to collect $337.48.

The printing company filed a counter claim and alleged that it had been discriminated against, and that other consumers had been given much lower rates.

William H. O'Brien, president of the printing company, is a lawyer. It was the opinion that Union Electric. being a public service corporation, had no right to charge him 20 cents a kilowatt hour for electricity when it was selling electricity to other consumers for 5 cents a kilowatt hour, or less.

Accordingly he filed a counter claim for $234.45 for alleged overcharges. Mr. O'Brien succeeded in finding several consumers using a much smaller quantity of electricity than the printing company was that were getting service as low as 10 cents a kilowatt hour. His rate was 20 cents a kilowatt hour, with discounts which made his net rate about 14 cents.

After the decision of the Supreme Court of New York in the case of the Armour Packing Company against the Edison Electric Illuminating Company was made public the Union Electric attorneys dropped the case against the O'Brien company. In this case the Armour company proved that it paid a lower rate for service than other concerns and the court decided that as the Armour company "unaware of the discrimination, paid the company sums in excess of that charged others for the same service and under the same conditions, the payment was under the mistake of a material fact and hence, the exaction of the excess, being unlawful, it was recoverable."

Articles of incorporation were filed Wednesday, by the West End Light and Power Company, a corporation to furnish electric light, operating under the franchise of Browning, King & Co.

SYRACUSE, N. Y.—In his monthly report of the work done in the Bureau of Gas and Electricity, Superintendent Henry J. Blakeslee tells of beginning a regular test of gas meters at the meter shop of the Syracuse Lighting Company. This will be carried on steadily and it is expected to guard against the sending out of defective meters. Of the 1,077 meters tested during April, 155 were found defective.

Mr. Blakeslee found seventy-three meters which registered more gas than actually passed through them. Meters to the number of sixty-nine registered too slow, and thirteen were found to be leaky and otherwise out of order. The other 922 meters were found to be correct and were badged and sealed.

WASHINGTON, D. C.—The Commissioners yesterday forwarded to Chairman Smith, of the House District Committee, their report on the bill proposed to amend the act of 1895, regulating the sale of gas in the District of Columbia, proposing to substitute the Steward slit union burner for the Bray slit union burner. The Commissioners report that the tests would seem to indicate that the Steward burner is a fit burner for the use of the consumer, but is not suited for use in making official candle-power tests.

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## *Contents of This Issue.*





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# Illumination and Recreation

The development of modern illumination has removed the limitation which the darkness of night formerly placed upon human labor. This has virtually doubled the hours of the day during which the work of man may be carried on, and yet the hours actually devoted to labor by the individual is less at the present time than ever before in the world's history.

While illumination has thus added to the total results of human labor, while subtracting from the work-hours of the individual laborer, it has also added to the opportunities and possibilities for recreation. Consider for a moment the present day output of books, magazines, and papers; what portion of these are read by artificial light? Reading was formerly, for purposes of instruction, indulged in only by scholars. The pursuit of literature as a recreation for the masses is of modern origin, due largely to the development of good artificial illumination.

Picture to yourself the theater of Shakespeare's time, lighted with a few candles, the stage a mere platform without scenery or properties of any kind. Contrast this with the modern production of a Shakespearian play, and you will have some realization of what illumination has done for the realism and impressiveness of the drama.

Before street lighting became general, only those ventured out at night who had urgent business, or who were able to go well attended, or who were bent upon despoiling the former two classes. Modern public lighting has done for the safety of the streets and towns what an army of watchmen or policemen could not accomplish. Thus the leisure hours are made available for the occupations that are properly pursued for recreation.

That millions of people, young and old, who are of necessity kept at their labor in the close quarters of the city during the day can enjoy the cool, refreshing air of country, lakeside, or sea shore during the evening is another of the priceless boons which illumination has bestowed upon the present generation.

Not only does light afford the opportunity, but of itself adds to the enjoyment. The brilliant lighting of the electric car is itself a delight, and the myriad lights that convert the summer park into a veritable fairy land are an incentive to enjoyment, and a vanquisher of mental as well as physical gloom.

LET THERE BE MORE LIGHT!

E. L. Elliott.

THE CANDLE OF CRUDE COAL-WAX, OR OZOKERIT.

# Some Curious Methods of Lighting Still in Use To-Day

L. Lodian.

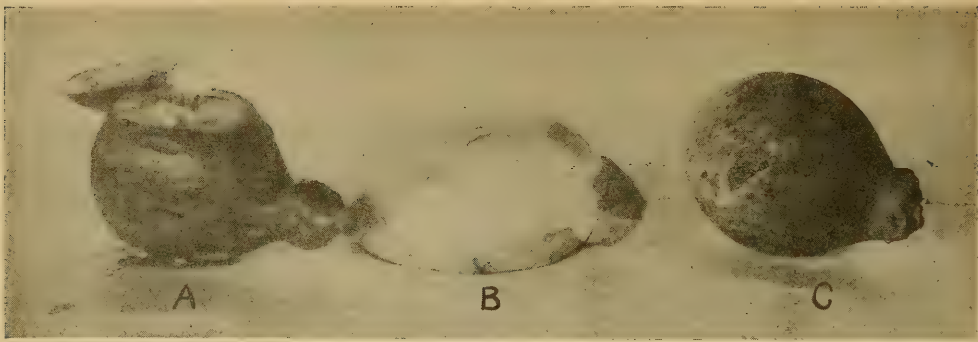
This paper will confine itself to actually existing curiosities in illumination—not the "what used to be" of the hoary past. The object is to show that, amid all the most improved and ablest systems of lighting the globe has ever known, the quaint and the crude—the barbarous, if you will—persists almost side by side with the most modern.

Here and there in some of the Sicilian basements along Manhattan's Mulberry Street, you see gourd-shaped objects containing a small light. They are semi-translucent containers, thus casting a dim light around and below, and take the place of night-lights. This singular illuminant is, or was, pure butter; it is the *bala-burro* (ball-butter) of the Italians; but, becoming so rancid as to be unfit for table or kitchen use, is utilized as a light with some bits of string for a wick. The gourd-like container is of pure cheese, which had been worked up in a lukewarm state rapidly about the ice-cold ball of sweet butter, then rapidly cooled, and finished on ice.

Butter may thus be preserved unsalted for a very long time, and both interior and exterior are always perfectly edible. But trade "returns" of stock do, however, contain a percentage of rancified ones, and it is these which are used as lights. When exhausted, the "Dago" may either refill with more rancid butter, or open up another butter-ball. The cheese-container is never contaminated by the rancid contents, and is finally used up in the soup-pot by the thrifty Ligurian, or is ground into powder as a macaroni condiment.

The farmhouses of central Polonia (Polska) and Hungary often use the home-made coal-wax dingy, greenish-black candle. This is the crude ozokerit obtained from the bituminous shales in the region. They dig it up themselves, and clean it of impurities somewhat by throwing into boiling water, when the wax rises to the surface. It has an uninviting kerosene odor, and the light is not good, with always more or less smoke. But the same ozokerit, decolored, becomes a pure cream-white product, and is the cerasin of commerce, from which very high-grade candles are made. Many years ago a Paris firm tried to market the natural-color black coal-wax candles, guaranteed smokeless, but it proved a total failure.

Another curious light right in our own America—or rather off its coast—is the "candle-fish." The fishermen in their smacks off the Pacific slope prize a few of this fish solely for its oiliness. After air-drying, a piece of oiled tow is rammed down its gullet, and lighted. It makes a sputtering, disagreeable, flickering light, but better than nothing in the usually utterly cheerless forecastle. It naturally consumes with an offensive burning-bone




A. BUTTER-BALL USED AS A CANDLE. B. FRESHLY-MADE BALL. C. BALL AS SOLD IN THE MARKETS.

odor, and a maximum of smoke, and is probably the worst makeshift light known

In a recent paper in the *Scientific American,* I commented, anent some of the food-products of other nations, on the singular tallow-bread of some of the natives of Cibiria. This is a ringed bread, so permeated with tallow as to be usable as an illuminant in their tents and huts. Very narrow strips cut off their camel-hair sheeting are soaked first in tallow, then pulled through a hole bored in the bread. It makes a fairly good wick, considering, but the light also gives off a slight odor of burning bread.

Kopra (also spelled various other ways) is the sun-dried cocoanut of oil-mill commerce and export. "Fingers," so-called, of this, are cut off the dried halves and used as lights in many parts of the Asiatic mainland and the islands of Polinesia. Completely desiccated, the "fingers" are hard as wood, and burn rather too rapidly on warm evenings. The charred snuff has constantly to be knocked off to prevent the light growing dim; otherwise the light yielded is fair, with a minimum of smoke; but the unmistakable pervading odor of cocoanut-oil fumes is almost always there—somewhat nauseating on sultry eves.

Curiously enough, this crude kopra light is the original of the old, old saying, "to burn the light (or candle) at both ends," in allusion to unwisely using up one's vitality. The Asiatic proverb is the forebear of the quotation as we know it today. It would be highly impracticable, in fact, to burn a candle at both ends simultaneously, but the naturally-curved semicircle of the kopra "fingers" admits of this two-end simultaneous burning perfectly, and this is often done by the natives of Oceania and Indasia when they desire more light; but in that case, in handling the light, it is less convenient to hold it from the center.

Of course, the expressed oil of the kopra is also used in vast quantities in the Orient as an illuminant, in lamps, but being always a liquid in those latitudes, it is not nearly so convenient for transport as the kopra. Besides, the kopra is a partial food, and is often eaten by caravan parties during the long overland journeys, although life cannot be sustained on it. Thus the kopra light of millions of Asiatics to-day is remarkable as being the only combined partial food and light known.

There are probably a score other singular methods of illumination in vogue about the globe, but to illustrate and note even half of them would run into half a dozen more pages. The subject may be returned to at a later date, if there is any interest in it. As it is, enough has been instanced to convince the illuminating engineer that he has a *raison-d'etre* with plenty of missionary work ahead.

THE KOPRA LIGHT OF MILLIONS OF ASIATICS.

# Lamp-posts

By "Multipolaris."

In the course of time men and things usually get their just deserts. The prophet despised in his own generation is worshipped in the next. The invention that is ridiculed to-day is the reigning wonder to-morrow. The epic poem, spurned from the publisher's sanctum, goes echoing down the corridors of time.

> The evil that men do lives after them;
> The good is oft interred with their bones.

But there is a resurrection day, when the good arises in all its strength and glory. The great man, the great deed, or the great thing often requires a distant view to bring out its true proportions: happy the man or the time that discovers unrecognized greatness.

It is therefore with a feeling of reverence amounting almost to awe that we essay to lift the veil of obscurity from that heretofore despised and neglected, but essentially great thing—the lamp-post.

We have had philosophies innumerable since man first began to solidify his thoughts by symbols and written characters. We have had philosophies of the origin of the universe; philosophies of virtue and of evil; philosophies of life, death, and immortality; philosophies of the heavens and of the earth; of matter and of force; of history, and of politics. We have even a most edifying philosophy of clothes, but as yet no philosophy of lamp-posts. Surely this is not the fault of the lamp-posts, but of the philosophers.

In point of definiteness of conclusion and practical utility of results, lamp-post philosophy should at least equal—nay, should even excel, that of many of the philosophies enumerated. Thus, the philosophies of the universe have brought forth the potent truth: "Whatever is, is." There would seem little ground for dissent from this conclusion, but like most other philosophic conclusions, it is denied by a modern school of thought—manipulators who have reduced the universe to the final formula, "Whatever is, is not."

Again, the philosophy of life and death is summed up in the statement, "Given the former, the latter is inevitable." What either one is, no philosopher has yet discovered. The philosophy of history declares that "experience"—which is another word for history—"is the great teacher"—to which another philosophy adds: "but has only fools for pupils." "And, therefore, teaches all men," promptly and truly replies the first philosophy. The philosophy of politics emphasizes the perpetual need of reform—but leaves unanswered the greater question, "Who shall reform the reformers?"

All of the philosophies of what have been supposed to constitute the really great problems seem to have brought forth little of practical value. They will not make two blades of grass grow where but one grew before, nor butter any parsnips that have already been grown by the unphilosophic tiller of the soil. Doubtless the most useful of all the philosophies is that of clothes, as set forth in that remarkable work of Prof. Teufelsdröck. Clothes are something tangible and visible—at least those of men. They are at once a necessity, a luxury, a misery, and a comfort; a constant reminder of the halcyon days of our first ancestors, and of the virtue of minding our own business instead of prying into secrets with which we have no concern. "Clothes may not make the man" says a present-day philosopher, "but they make all you can see of him except his face and hands during business hours."

But it was only the general importance of clothes philosophy that we intended to bring out, and not a detailed review of the important precepts and conclusions which it contains: it is the philosophy of the lamp-post that we wish particularly to expound.

First, then, let us consider the important part that the lamp-post has played in the advancement of civilization. In all history there is no example of such strange neglect in recognizing the true importance of man or thing. There was a time before the lamp-post was. Think for a moment of the condition of civilization in that long period. Ignorance was the rule; learning the rare exception. The printers had not

yet struck for an eight-hour day. The sum total of scientific knowledge would not make a respectable free text book for a modern public school. People believed in ghosts and witches. Half of the world was undiscovered. The lives and welfare of the many were at the mercy of the few. Bigotry and intolerance stalked unmolested through the world, seeking whom they might torture and burn. Might was right. But with the advent of the lamp-post a cataclysmic change, morally, spiritually, and intellectually, took place. Knowledge rapidly increased, and was filtered into the smallest crevices of the populace through the medium of the printing press. The scientific spirt of inquiry and investigation became the spirit of the age. So rapid was the march of progress that after the lapse of but a single century which encompasses the age of the lamp-post, mankind has reached a higher plane of general intelligence than had been achieved in all the preceding milleniums.

In view of these indisputable facts, can there be any doubt as to the importance of the lamp-post as a factor in civilization? Is not this good philosophy? Are we not asked to accept creeds and religions based on the same process of reasoning?

Next, consider what matters of inherent interest are centered in and about the lamp-post. It is a simple thing in principle; but as it exists at the present time it is totally beyond the powers of the mighty nations of the past to have produced. Neither ancient Babylon, nor Syria, nor Egypt, nor Caldea, nor Persia, nor China could have made either a lap- or butt-weld gas pipe. Steel trusts were unheard of. The idea of the destructive distillation of coal had never loomed upon their mental horizon. They had no gas meters, no public utilities commissions. Had they even succeeded in constructing a lamp-post they would have had no glass globe with which to sorround the light. Could a modern boulevard globe have been put into the hands of any of these ancient nations, it would have immediately found lodgment in the king's palace, or been worshipped as a fetish in the temple.

The lamp-post has also played its part in the great drama of human life. It is not unfamiliar with tragedy. More than one poor sinner has expired in suspense between the cross arms of a lamp-post above and the pavement below. Unless we are mistaken, the great city of New York has been a witness to such tragedies. Nor is it unfamiliar with romance. How often has love's young dream sighed out its yearning pains within the protecting shadow of the lamp-post! You who doubt this have never prowled about a great city at night. With comedy the lamp-post is on most familiar terms. How its molecules must vibrate with metallic laughter when a youth, delirious with delight and the memory of recent bliss, embraces it and softly murmurs, "Yeth, my dear Mabel, you danth exquisitely."

Besides the important part it has played in civilization, and apart from its vital connection with the great drama of life, the lamp-post is an object of art. Perhaps you have heard the stanza that runs thus:

> A primrose by the river's brim,
> A yellow primrose was to him
> And it was nothing more.

Such is the deplorable lack of appreciation of art that, we are pained to admit, to the majority of beholders the lamp-post is a cast iron tube, and it is nothing more. Happily this state of affairs is rapidly changing. Cities are appointing commissions to fitly embellish and glorify this heretofore neglected exponent of art and civilization. Competitions are opened in which the great masters are invited to participate; and, impatient at the law's delay, funds are being raised by private subscription to place these emblems of the reign of science along the principal streets and parks. It seems at last that justice is to be done, and that the lamp-post is to come into its own.

We cannot more profitably close our very brief and incomplete discussion of this theme of world-wide interest than by the study of a few recent examples. The reader may first turn his critical eye to the example shown in Fig. 1. We have here a granite column of the Roman-Doric order, supporting a granite ball on top. The column is of massive construction, and apparently some 12 or 15 ft. high, as may be judged by comparing it with the figure at the base, so happily introduced by the photographer. The column is of the same order as those used in the building in the background to support the roof, and is of greater strength, being a monolith of one of the most durable of stones, whereas those in the building are

FIG. 1.

of brick. As far as strength is concerned there is very little fear that the ball on top, for whose support the column was evidently erected, will fall. That it might easily topple off, and carry destruction to the lanterns and by-standers below, may be readily conceived, as it apparently rests upon a small, level support. A careful consideration of the matter, however, would lead to the conclusion that such a catastrophe has been provided against by the use of a steel dowell pin; or possibly the ball is integral with the column—the point of attachment being hidden by the capital. Why this granite ball should need to be held up for all time just at this particular altitude and location we must confess is a question too deep for us to answer. Advantage is taken of the presence of the column to use it as a support for two lanterns of such massiveness as to suggest that they might have once served as lighthouses. The lanterns themselves partake of the Gothic order, while the supporting cross-arm is present-day American. The progress of art in architecture from the earliest developments in Greece, the subsequent modifications of the Roman imitators, the original creations of the later Goths, and the mechanical ingenuity of the present-day Americans is thus embodied in this single instance: a most conclusive proof that the lamp-post is an epitomized embodiment of the history of civilization.

The keynote of the genius of America is adaptability. This arises from the spontaneous growth which has been the natural result of our entire freedom from the restraint of prejudice and precedent. Thus our mental activities, instead of merely winding about the dead and dry bean-pole of custom have sprouted out in every direction, according to their natural inclinations, like a potato left uncovered in the sunlight.

The refinement of Greek architecture was reached in the Corinthean order; and the Corinthean column, with its exquisitely curved vertical outline, its flutings to bring out more perfectly its roundness when seen in brilliant sunlight, the chaste beauty of the conventionalized lotus leaf forming the decoration of the capital, together produce a harmony of form that has never been surpassed. "If such a column is beautiful when supporting the roof of a Greek temple, why may it not support a clock?" says the versatile American; and straightway the thought is embodied in enduring cast-iron, as shown in Fig. 2. "I need a lamp-post," says the

FIG. 2.

FIG. 3.

electrical engineer. "I have it," instantly replies the architect, with whom the difference between clock-posts and lamp-posts is only one of etymology. "A post have I; I will put a lamp upon it—now it is a lamp-post." (See Fig. 3.) To point out that the square plate forming the top of the capital owes its existence to the fact that the original purpose of such columns was to receive the abutting ends of supporting timbers or stone lintels is but to acknowledge your fear of tradition. If it supported a lintel, it may support a lamp; and so a spun metal "canopy," turned upside down, a lamp socket, a shade holder, and a globe—all quickly produced from the stock room—complete the equipment, and produce a wasp-like grace never dreamed of in the days of Pericles.

Our next example (Fig. 4) shows a further development of the versatility of which we have spoken. The fluted column has become more attenuated, and therefore far better proportioned to the weight which it has to support. The Corinthean capital has been retained, but the square flat plate on top has been modified to a mere reminiscence, while the elements of the Doric capital are shown in an embryonic state, so to speak, immediately underneath. The wasp-like neck is still retained, however, but the whole has been refined. The base of the column is purely twentieth century American, and thus in harmony with its immediate environment. Furthermore, the position of the post on the coping of the wall marking the corner of the platform is well chosen. Altogether, we share the wish of our masculine reader that we were seated on the steps at just a respectful distance, that we might further contemplate the combined beauties of nature and art before us.

Even the best of art jars the æsthetic sense when out of place. An example of this is shown in Fig. 5. The lamp-post here is of the same design as noted above; but instead of being placed upon the balustrade, where it would serve its purpose without being in the way, it has been placed on a little square platform immediately in front of the side steps, where it must inevitably come into collision with your head should you chance to fall down the side stairs. Such contingencies as these should never be suggested. Furthermore, the post has a temporary, even transient appearance, as if it were waiting the arrival of a moving van, whereas the very essence of art is permanency.

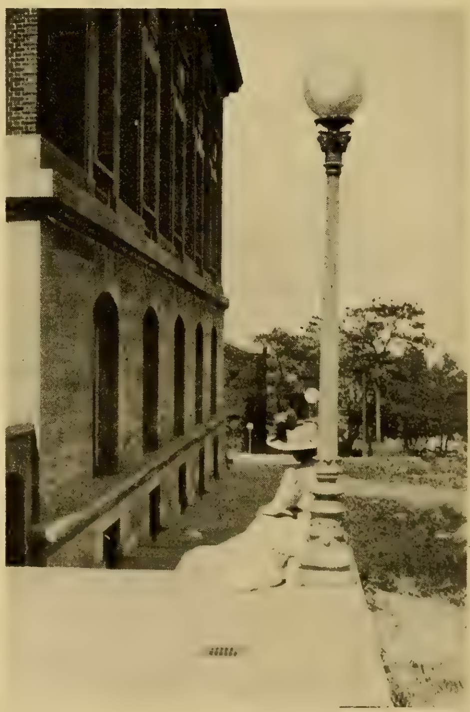


FIG. 4.

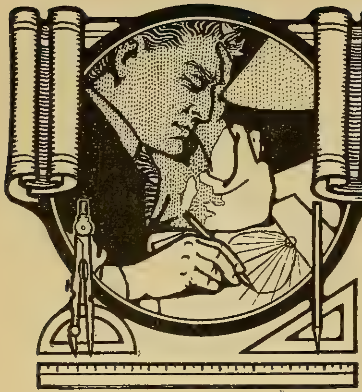
FIG. 5.

With one more example we must close this limited survey. We now turn from Greece to Rome—or out of the frying-pan into the fire, metaphorically speaking. The lamp-post here is a cast-iron embodiment of the lictors' bundle of rods. It was the emblem of the authority of the Roman states—the rod signifying the power to chastise; hence probably the derivation of the word "licking," which had a serious meaning to us in our boyhood days. But perhaps in this case the symbolism was intentional; the lamp-post may stand in front of a Court of Justice, or Tammany Hall. This hope is ruthlessly shattered by deciphering the word "Hotel" over the entrance of the building. The emblem of authority therefore must have reference to the hotel clerk.

"But if these examples are imperfect," the reader may say, "why not show us a perfect specimen?" Critics have been commonly misunderstood. Their mission is to point out the bad, not to create the good. The critic is essentially a reformer, and as everybody knows, the reformer's business is to knock down and drag out; rehabilitation falls to the lot of the reformed. If the people insisted on every literary critic writing books that were above criticism, art critics painting pictures which were beyond reproach, and reformers formulating plans and systems which would work out in practice, there would be no critics and reformers, and this would be a loss to society which would reduce it to the verge of moral and spiritual bankruptcy. Without critics we would have no means of knowing what good literature and art really is, and without reformers we would not even know that we needed reform; with such ignorance prevailing it is easy to foresee what sort of a state the world would forthwith fall into. If we were forbidden criticism, moreover, how many of us would be deprived of the mainstay of our conversation. Plucking the beams from our brothers' eyes is a vastly more entertaining pastime than seeking the motes in our own.

Lastly, it may be remarked that the lamp-post furnishes an infallible guide by which to judge the general character of the community in which it is found. Show me a rusty, wabbly iron post, with an old style lantern with begrimed glass, having a flaring, struggling gas flame within, and I will show you a town in which public spirit is largely confined to that sold over the bars, and public progress jogs along in a mule cart over a cobble stone pavement. If you are looking for a town in which to settle down, or to invest your money, flee the city of the dilapidated lamp-post and the infrequent street lamp as you would Sodom and Gomoroh.

FIG. 6.



# Practical Problems in Illuminating Engineering

## Artificial Lighting of School Rooms

By A. J. Marshall and T. W. Rolph.

School authorities seem to be awakening to the fact that most careful thought and attention should be given to the character, placement and use of artificial illuminants.

The first thing to be considered in designing a lighting system for a school room is the effect which the system will produce on the eye and the elimination of all possibility of this effect being injurious. Of course, this point should be carefully considered in designing any and all lighting systems, but it should receive special attention in this particular class of work. The eye is a most delicate instrument, and like all such instruments demands careful attention, and while it is wonderful in its recuperating powers and ability to stand up under strain, yet there is a " breaking point," and when that time arrives the ability to " see " is usually materially lessened. Resort must then be made to artificial means, namely, glasses and medical treatment to endeavor to carry out the functions of nature. Glasses and medical treatment, however, merely assist nature in carrying out the ordinary functions of the eye, and do not eliminate the primary cause of the trouble. It is therefore obvious that the chief thing to do is to remove this cause, which is usually the improper use of artificial illuminants.

A consideration of some statistics on defective eyesight of school children will perhaps show better than any other one thing the need of proper lighting in school rooms. Dr. Hermann Cohn, of Breslau, states that short sight has become more prevalent with the increasing tax on the eyes entailed by more severe school work, until, of the pupils who remained at school the full fourteen years, 63 per cent. were found to have defective sight. The report of Dr. Maximilian Bondi, of Vienna, supplies similar high figures. (*British Medical Journal,* February 4, 1905, page 258.) In Germany the government has been making strenuous efforts to remove the cause of this evil, and it is stated that a commission of architects and engineers will be created to decide on the proper method of lighting all school buildings to be erected.

In America, also, statistics show the need of action. School children's eyes examined in Vermont showed that 34 per cent. were defective, while in New York, out of 58,948 children recently examined, 17,938, or about 30 per cent., had defective vision. Prof. W. D. Scott has quoted even higher figures, but those stated above are enough to show the necessity of giving intelligent thought to a revision of the lighting in our public schools.

A notable instance of the attempt on the part of school authorities to eliminate the existing evil was the Committee of Oculists and Electricians, appointed April 29, 1907, to report on the Artificial Lighting and color schemes of the School Buildings of Boston. The findings of this committee are contained in School Document No. 14, dated November, 1907. Briefly stated, the chief recommendations of the committee were that all light sources be placed out

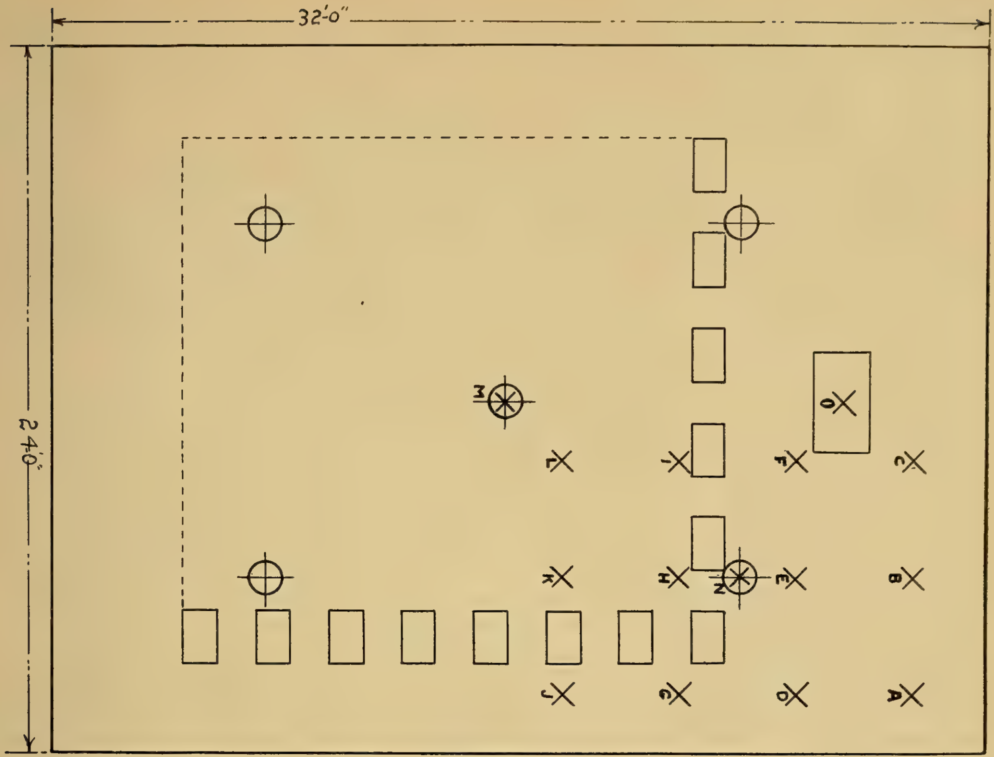



FIG. 1.

of the ordinary line of vision; that light sources be softened to such an extent that if brought into the line of vision their intrinsic brilliancy would not be too great for the eye to endure; that light sources should be arranged so that the dominant shadows are thrown from left to right on the pupils' desks; and that a uniform illumination of approximately 2.5 foot candles be secured on each desk. The committee also reported on the question of color and decoration of school rooms, and advised the adoption of certain light shades of green and buff.

The authors recently conducted a series of tests on some school rooms in Newark, N. J., and obtained results which have considerable bearing on the question of proper lighting. The tests were conducted on June 17, 1908, from 8 to 11.30 p.m. Three systems of illumination were under consideration and a test was made on each system, the idea being to determine in each case the average intensity of illumination on the desks and the maximum variation in illumination.

Tests were made in class rooms No. 19 and No. 14 of the Burnett Street School. Each room was 32 ft. in length, 24 ft. in width, and 12 ft. 3 in. in height. Windows were located on the left hand side of the room when facing the teacher's desk, and on the other three sides there was a blackboard. The ceiling and upper part of the walls were white.

In room No. 14, five outlets were used, located as shown in Fig. 1. Each outlet was equipped with one 75 cp. frosted tip Gem lamp and Holophane reflector No. 6080, the interior of which was coated with light enamel. The bottom of the lamp was placed at a point 10 ft. 3 in. above the floor, and as the desks were 2 ft. 3 in. in height, the height of the lamp above the plans was 8 ft.

In the second test the same room and outlets were used; each outlet, however, was equipped with one 100 Watt frosted tip Tungsten lamp and Holophane reflector No. 6060, with light interior enamel. The lamps were placed at the same height as in the first test.

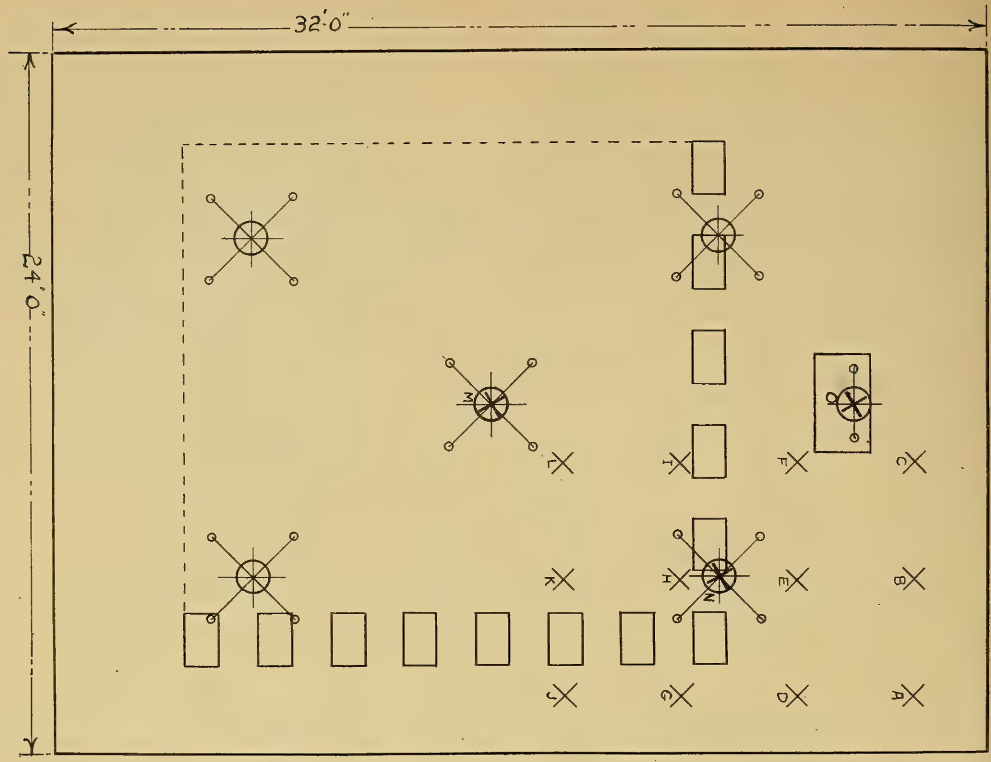



FIG. 2.

The third test was made on the lighting system which is at present used in this school. Six outlets were supplied on the ceiling of the room. Each of the five central outlets was equipped with a four-light chandelier, each light being composed of one 16 cp. clear, carbon-filament lamp and an 8½ in. flat porcelain reflector. The lamps were placed in a pendant position at a point 6 ft. 10 in. above the floor. The spread of the arms on the fixtures was 4 ft. Over the teacher's desk a similar two-light fixture was placed, having a spread of 2 ft. 8 in.

The instruments used in the tests were a Sharp-Millar Photometer, with 112 volt test lamp, standardized for the instrument, a Weston A. C. and D. C. Voltmeter, and a Weston A. C. Ammeter.

The method of conducting the test was as follows:

One-fourth of the room was divided into twelve squares of equal size. One station was taken at the center of each square, these stations being lettered from A to L. The average then of the readings at these stations gives the average illumination in the room. Additional readings were taken directly under the central light and under the light included within the quarter of the room considered, as these points were likely to be points of maximum intensity. A reading was also taken directly on the teacher's desk which was 2 ft. 6 in. in height. At each station three readings were taken and the mean was considered the illumination at that point.

The current supplied during the test was alternating, 60 cycles, and the voltage varied from 120 to 123. Wattage readings were taken with a voltmeter and an ammeter. As the authors were not aware of any inductive load on the line, the power factor was assumed to be unity or nearly such.

After the test was completed, corrections were made for the voltage of the lamps. Since the illumination increases approximately in proportion to the increase in the candlepower of the lamps, the illumination readings were corrected for the candlepower which the lamps would give at rated voltage. These values were determined from the voltage candle-

power characteristic curve of each particular type of filament. The curves for the carbon filament and metallized filament lamps were obtained from a paper by Clayton H. Sharp, on New Types of Incandescent Lamps, delivered before the American Institute of Electrical Engineers, November 23, 1906, in New York. The characteristic curve for the Tungsten lamp filament was obtained from the Engineering Department of the National Electric Lamp Association.

The results of the tests were as follows:

TEST NO. 1.

Room No. 14—Five 115-volt, 187-watt, 75-c.p. frosted tip Gem lamps; Holophane reflectors No. 6060, "Lunar" (light) interior enamel, form "H" holders.

| | |
|---|---|
| Ceiling height | 12′ 3″ |
| Desk height | 2′ 3″ |
| Height to bottom of lamp | 10′ 3″ |
| Height of lamp above plane of illumination | 8′ 0″ |

| | *Watts corrected for rated voltage.* |
|---|---|
| Circuit No. 1—2 lamps | 354.3 |
| Circuit No. 2—3 lamps | 539.2 |
| Total watts | 893.5 |
| Watts per lamp | 177.4 |

| *Station.* | *Mean foot-candles corrected for rated voltage.* |
|---|---|
| A | 1.40 |
| B | 1.77 |
| C | 1.71 |
| D | 1.72 |
| E | 2.58 |
| F | 2.60 |
| G | 1.96 |
| H | 2.84 |
| I | 3.04 |
| J | 1.69 |
| K | 2.28 |
| L | 3.10 |
| M | 3.41 |
| N | 2.94 |
| O | 2.32 |

| | |
|---|---|
| Mean foot-candles throughout room | 2.22 |
| Mean foot-candles on desks | 2.74 |
| Maximum variation from mean throughout room at Station M..Plus | 53.6% |
| Maximum variation from mean on desks at Station M ........Plus | 24.4% |
| Watts per square foot | 1.16 |
| Watts per square foot per foot candle | 0.52 |

TEST NO. 2.

Room No. 14—Five 115-volt, 100-watt, 80-c.p., frosted tip Tungsten lamps with Holophane reflectors No. 6060, "Lunar" (light) interior enamel, form "H" holders.

| | |
|---|---|
| Ceiling height | 12′ 3″ |
| Desk height | 2′ 3″ |
| Height to bottom of lamp | 10′ 3″ |
| Height of lamp above plane of illumination | 8′ 0″ |

| | *Watts corrected for rated voltage.* |
|---|---|
| Circuit No. 1—2 lamps | 167.2 |
| Circuit No. 2—3 lamps | 274.1 |
| Total watts | 441.3 |
| Watts per lamp | 88.3 |

| *Station.* | *Mean foot-candles corrected for rated voltage.* |
|---|---|
| A | 2.10 |
| B | 2.39 |
| C | 2.47 |
| D | 2.51 |
| E | 3.83 |
| F | 3.53 |
| G | 2.78 |
| H | 3.98 |
| I | 4.22 |
| J | 2.38 |
| K | 3.08 |
| L | 4.63 |
| M | 4.97 |
| N | 4.35 |
| O | 3.27 |

| | |
|---|---|
| Mean foot-candles throughout room | 3.16 |
| Mean foot-candles on desks | 3.88 |
| Maximum variation from mean throughout room at Station M..Plus | 57.3% |
| Maximum variation from mean on desks at Station M .........Plus | 28.1% |
| Watts per square foot | 0.57 |
| Watts per square foot per foot-candle | 0.18 |

TEST NO. 3.

Room No. 19—Five 4-light chandeliers and one 2-light chandelier, each light consisting of 1 16-c.p., 115-volt, clear carbon-filament lamp and 8½″ flat white porcelain reflector with standard 2¼″ holder.

| | |
|---|---|
| Height of room | 12′ 3″ |
| Height of desks | 2′ 3″ |
| Height of bottom of lamp | 6′ 10″ |
| Height of lamp above plane of illumination | 4′ 7″ |
| Spread of 4-light fixtures | 4′ 0″ |
| Spread of 2-light fixtures | 2′ 8″ |

| | *Watts corrected for rated voltage.* |
|---|---|
| Circuit No. 1—Two 4-light fixtures and one 2-light fixture | 471.7 |
| Circuit No. 2—Three 4-light fixtures | 581.6 |
| Total watts | 1053.3 |
| Watts per lamp | 47.9 |

| *Station.* | *Mean foot-candles corrected for rated voltage.* |
|---|---|
| A | 1.12 |
| B | 1.67 |
| C | 2.48 |
| D | 1.66 |
| E | 3.28 |
| F | 3.60 |
| G | 2.01 |
| H | 3.69 |
| I | 3.82 |
| J | 1.59 |
| K | 2.26 |
| L | 3.84 |
| M | 4.84 |
| O | 3.94 |

| | |
|---|---|
| Mean foot-candles | 2.59 |
| Mean foot-candles on desks | 3.42 |
| Maximum variation from mean throughout room at Station M | Plus 86.9% |
| Maximum variation from mean on desks at Station M | Plus 33.9% |
| Watts per square foot | 1.37 |
| Watts per square foot per foot-candle | 0.53 |

The three systems considered compare as follows:

| | *Mean foot-candles on desks.* | *Total watts.* | *Cost of operation per year.* |
|---|---|---|---|
| System No. 1 | 2.74 | 893.5 | $28.362 |
| System No. 2 | 3.88 | 441.3 | 18.653 |
| System No. 3 | 3.42 | 1053.3 | 38.693 |

The cost of operation per room per year includes

Interest on investment,
Depreciation,
Renewals,
Current.

Investment was figured as the cost of the equipment for the outlets. Depreciation was figured at 12½ per cent. Renewals and current were figured on the basis of 250 burning hours per year, since the school is used for four months of night school work, and there would be occasional lighting of the lamps late in the afternoon on dark days.

The comparative cost for the three systems is as follows:

SYSTEM NO. 1.

| | |
|---|---|
| Interest on investment | 1.291 |
| Depreciation | 2.258 |
| Renewals | 1.438 |
| Current | 23.375 |
| Total | 28.362 |

SYSTEM NO. 2.

| | |
|---|---|
| Interest on investment | 1.570 |
| Depreciation | 1.958 |
| Renewals | 2.625 |
| Current | 12.500 |
| Total | 18.653 |

SYSTEM NO. 3.

| | |
|---|---|
| Interest on investment | 3.630 |
| Depreciation | 7.563 |
| Renewals | 0.000 |
| Current | 27.500 |
| Total | 38.693 |

With the illumination as obtained the increased cost of

| | |
|---|---|
| System No. 3 over System No. 1 is | 36% |
| System No. 3 over System No. 2 | 108% |
| System No. 1 over System No. 2 | 52% |

Variations in illumination as high as 20 or 25 per cent. need not be considered serious, as the eye adapts itself very readily to these variations, and they are scarcely noticeable under ordinary conditions. The variation in illumination in the rooms considered can be reduced to within this figure by a change in the location of outlets.

System No. 3 should be rejected for the following reasons:

1. The effect of the lighting system as a whole is injurious to the eyes of the pupils. The lights are less than 7 ft. above the floor and come directly within the range of vision. The lamps are clear and the reflector used does not hide any portion of the filament.

2. The cost of operation of this system is excessive compared with the cost of the other systems, being 36 per cent. in excess of system No. 1 and 108 per cent. in excess of system No. 2.

One outlet more than in the other systems is necessary, thereby causing a higher cost for wiring.

3. The illumination from system No. 3 is inferior to that obtained from system No. 2. Comparing system No. 3 with system No. 1, the former shows 3.42 foot-candles on the desks while the latter shows 2.74. It is propable, however, that the effective illumination is very nearly the

FIG. 3.

same in the two cases. This is due to the fact that the eye adjusts itself to the brilliancy of light sources within the range of vision. With the bare filament in the range of vision, the pupil of the eye becomes smaller, thus allowing less light to effect the retina than would be the case were the light sources absent. The illumination, therefore, appears less brilliant than it really is. A rough comparison of the two systems by the eye showed this to be correct, and if any difference in illumination was noticed it appeared to be in favor of system No. 1.

Systems Nos. 1 and 2 are both superior to system No. 3, but of the two systems No. 2 has the following advantages:

1. The cost of maintenance of system No. 1 is 52 per cent. in excess of system No. 2.

2. The illumination obtained with system No. 2 is 42 per cent. higher than that obtained from system No. 1. This is true of the effective illumination as well as of the actual illumination since the light sources are placed at the same height in each case, and are well above the range of vision, with the brilliancy of the light sources approximately the same for both systems.

Clear reflectors do not diffuse and soften the light as well as is desirable for school rooms. The additional diffusion necessary may be accomplished by enameling or sand-blasting. Enameling is superior to sand-blasting for the following reasons:

1. The diffusion is better.

2. The effect of dust is less noticeable and the reflectors are easier to clean.

3. The strength of the reflectors is greater. Breakage is less with enameled reflectors than with sand-blasted reflectors.

It is evident from the results obtained that system No. 2, consisting of five 100 Watt frosted tip Tungsten lamps and Holophane reflectors No. 6060, the inside of which is coated with a light enamel, used in connection with form "H" hold-

FIG. 4.

er, the lamps being 10 ft. 3 in. above floor, is superior in all details to systems Nos. 1 and 3. To obtain a more uniform illumination from system No. 2, than brought out by the illuminometer test, the four corner outlets should each be placed 9 in. nearer side walls and 1 ft. nearer end walls. If gas is to be used for emergency, same should be provided for by side bracket only.

As brought out in the first part of this article, the chief point to be considered in the use of artificial light in a school room is the effect which the lighting system as a whole will produce upon the children's eyes. Bearing this point in mind and referring to Fig. 3, which is a photograph of the school room in which system No. 3 was used, the glaring effect of the lighting installation should be noted. To fully appreciate this undesirable feature, the room itself should be seen. One could hardly conceive of a more trying installation on the eye. It might be interesting to note that in the report of the superintendent of public schools made last year, he stated that the Burnett Street School is the best lighted school in the city of Newark. All the school rooms in this school were lighted similar to that shown in Fig. 1. If good illumination consists only of a given intensity on the desk level, the rooms are, without a doubt, well illuminated. However, when the injurious effect produced on the eye is considered, the system must be condemned."

Fig. 2 shows a room similar in all details to that shown in Fig. 4, with the exception that in this room system No. 2 is in use. Photographs (Figs. 3 and 4) were both taken by the same camera and operator, and each was given an exposure of four minutes. Note in Fig. 4 the absence of glare, the well distributed and softened illumination, and the apparent greater size of the room, due to the absence of low hanging chandeliers which are in evidence in Fig. 3. The fixtures shown in Fig. 4 are temporary, having been put in for experimental use only. The fixture finally adopted will be simple and dignified in design.

# The Lighting of a Rug Store

By C. W. Kinney.

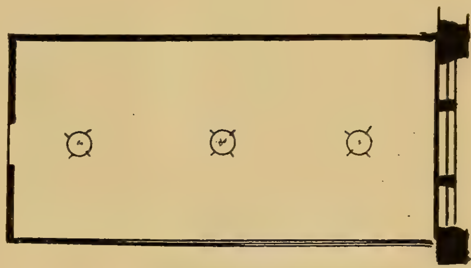
This store, which is 16 ft. by 36 ft. by 13 ft. high, with windows at the rear as well as the front, was originally lighted with three five-light 60 watt Tungsten chandeliers, this system having been installed for illuminating counters. The writer was called in to remodel the lighting system so as to light both walls and floor with a uniform intensity of from three to four foot candles.

The chief difficulties to contend with were a concrete structure with only the above mentioned three outlets for service, a bright yellow brick wall directly across the street from the rear windows; the space in front of the front windows was shaded, making the most difficult part of the work, the proper illumination of the front portion of the store during the day time; and lastly, a disposition on the part of the salesmen to have trough reflectors for lighting the walls, inasmuch as rugs were to be hung to cover the entire side walls. Trough lights had been used in other stores and the prejudice in their favor was strong, and demanded careful consideration.

The trough lighting proposition was the first one investigated. In view of the necessity of illuminating the entire area of the side wall, which was 12 ft. high, the plotting of the curves (using trough lights) showed that these troughs must be placed at a distance from the wall that would be difficult to accomplish in consideration of the structure of the building, and would in addition place the reflectors in a position that would interfere with the architectural beauty of the building.

The writer then procured curves of the Holophane street reflector No. 243, and proceeded to plot the illuminating possibilities with this shade and the fixtures already in use. Curves of candle foot illumination with five 100 watt Tungsten lamps in each of the three fixtures showed good results, with the fixtures close to the ceiling and supplied with the No. 243 shade.

It was thus decided to install the 100 watt lamps and No. 243 shades. The results of this installation were a uniform



PLAN OF STORE.

wall and floor illumination of sufficient intensity to display the dark tapestry to a good advantage, this illumination being obtained from a diffused source at a distance sufficient to give results such as would naturally exist in actual service. And further, by turning the "dark" side of the reflector toward the store entrance, the customer was not blinded by the glare so noticeable from many of the clear reflector types. As to the current consumption, the curves plotted indicated that at least 18 50-watt incandescent carbon filament lamps and five 40-watt Tungsten lamps would be necessary to accomplish the results obtained by using the five 100-watt lamps, in case the trough reflector had been used with the carbon filament lamps. Thus it will be seen that there was a marked saving both in original cost of installation as well as in cost of operation.

# Fixtures and Accessories

## The Limits of Art in Fixture Design

By E. L. Elliott.

It is a pardonable weakness, if weakness it be, for a workman or artisan to glorify his work. It is possible, however, to carry such devotion beyond the limits justified by conditions; and this is particularly true in the case of applied art. The fact must never be lost sight of that in every case of decorative, or applied art, the art itself is incidental, and the utilitarian purpose paramount. Decorative features or embellishments which in any way interfere with use are always out of place. This constitutes the first, and probably the most important limitation of art to fixture design.

A weed is defined as "a plant out of place"; it is not the character of the plant, but its environment, that determines whether or not it must be classed as a weed. The common daisy is much admired, and rightly so, considered by itself as a flower; but when it invades the farmer's meadow to the exclusion of grass, which is the legitimate occupant of the ground, it becomes a weed, rightly detested by the agriculturist. In its proper environment, as along a country roadside, or in any other place where it in no wise interferes with the rightful use of the soil, it is properly classed as a flower by reason of its natural beauty. The designer must first of all have a care that the flowers of his thought do not become weeds when materialized.

The interference with utility must be neither actual nor conceivable. An etched or otherwise obscured glass globe is legitimate because it actually serves a purpose in softening and diffusing the light; the *degree* of efficiency with which it accomplishes this valuable purpose does not at all affect its æsthetic value, since it is the general principle that determines the psychological phenomenon which we term "the æsthetic sense." To place metal, or other opaque substance, upon the surface of a globe in such a way that it has no real or apparent use in supporting the globe or fixture, is a direct contradiction of this principle, and at once offends the æsthetic sense. Similarly, to place a disc or saucer of metal directly underneath an electric lamp or gas burner is artistically repulsive, because it can serve no possible useful purpose, but on the contrary manifestly prevents the light from shining directly below the fixture, where it is most needed for illumination. This principle is not a matter of opinion; it is one of the laws of psychology underlying the science of æsthetics. We may observe here that æsthetics is a division of the broader science of psychology, and is therefore itself a thoroughly scientific subject.

Probably the next most important limitation to art in fixture designing is the principle that applied art must always be subservient. If the artistic embellishment or ornamentation can exist apart from the fixture, then it has no business being attached to the fixture. Thus, a statuette or medallion, no matter how well executed it may be, if placed on a fixture shows that both it and the fixture could exist as well separately, is out of place, and therefore a mere weed, artistically speaking.

This principle is recognized in mural decoration. Painting offers one of the great fields for the exercise of artistic skill, but the difference between canvas and plaster must never be lost sight of.

The mural painting exists by reason of the wall, whereas the canvas exists solely because of the painting. The minuteness of detail and fullness of delineation which form one of the chief merits of the painting on canvas, which exists for its own sake, would be so far out of place on a mural painting as to render it subject to severe criticism from the artistic standpoint. A notable case of this kind is the series of mural paintings in the Pantheon in Paris, which in themselves are works of undoubted merit, but which, according to the general consent of art critics, should have been on canvas instead of plastered wall. The fixture exists that it may afford illumination—not as a support for art metal work.

Another very decisive limitation to the application of art to fixture manufacture is cost. We discussed some of the bearings of art and commercialism in the last issue. There is still much to be said on this important topic. Art is always expensive, for the reason that artists are scarce, and by the universal law of supply and demand the results of their efforts command high prices. In the case of pure art the prices often reach a value that is largely fictitious, but this is seldom the case in applied art. It is doubtful if there is a single fixture designer, at least in this country at the present time, whose work would command a special price simply from the fact of his having designed it; in fact, it is very doubtful if the general public know by name a single designer of fixtures. Besides the expense of originating a truly artistic design, there is the additional expense entailed in its execution. The combination of these two items generally run into figures that are far beyond the appreciation or means of the average purchaser. As a result, the majority of fixture designing is on a dead level of mediocrity. For this regrettable state of affairs the manufacturer blames the purchaser, and the purchaser blames the manufacturer. The former says that people will not pay the money for high class work, and the latter replies that only mediocre stuff is offered. Probably both are right. Good art does not necessarily mean elaboration. In fact, an abundance of ornamentation is more often than otherwise a means of filling up the gaps in the designer's originality. The simple but artistic fixture may not be any more expense to make than the simple inartistic one, but it must necessarily bring enough more money to cover the work of the artist, or rather artisan, and unless the customer can appreciate the real art displayed, and the necessity of remunerating the artist, the fixture must prove a loss to the manufacturer.

The cost of manufacturing an article depends very largely upon the quantities in which it can be produced, but reduction in cost by this means almost inevitably carries with it the penalty of the stiff, mechanical, "hand-me-down" appearance that is wholly incompatible with the artistic sense. The most general and evident criticism that can be made on American fixtures is that they show at every turn the evidences of their origin in the spinning lathe, the drawing die, the tube works, and the brass foundry. They lack the human touch, which is at the bottom of all applied art.

Another limitation to art in fixture design is the distance from which the fixture is viewed. A wall bracket, which can be viewed at close range, can be properly given a much more detailed ornamentation than a chandelier which is to be suspended from the ceiling of a theater. Unquestionably it is preferable to err on the side of too little, rather than too much, detail. A fixture which shows that it contains detail which the eye is unable to decipher transgresses the law of æsthetics which states that the object must afford an evident and complete answer to the question: "What are you for?" Decorative art must never degenerate into a puzzle: the effect of the unsolved puzzle is unrest, which may amount to positive irritation, and the very basis of æsthetics is a sense of rest and ease.

The limitations thus far considered apply to decorative art generally, of which fixture designing is only a special case. There is an additional limitation which is peculiar to fixtures, and that is the fact that, in a sense, they are luminous bodies. The furnishings of a room are illuminated by the lighting fixtures, and it is part of the work of the illuminating engineer and the decorator to see that the illumination is such as to bring out their artistic features. But the lighting fixture gives its own light; one lighting fixture is not put up to illuminate another. In the large majority of cases the illumination of the

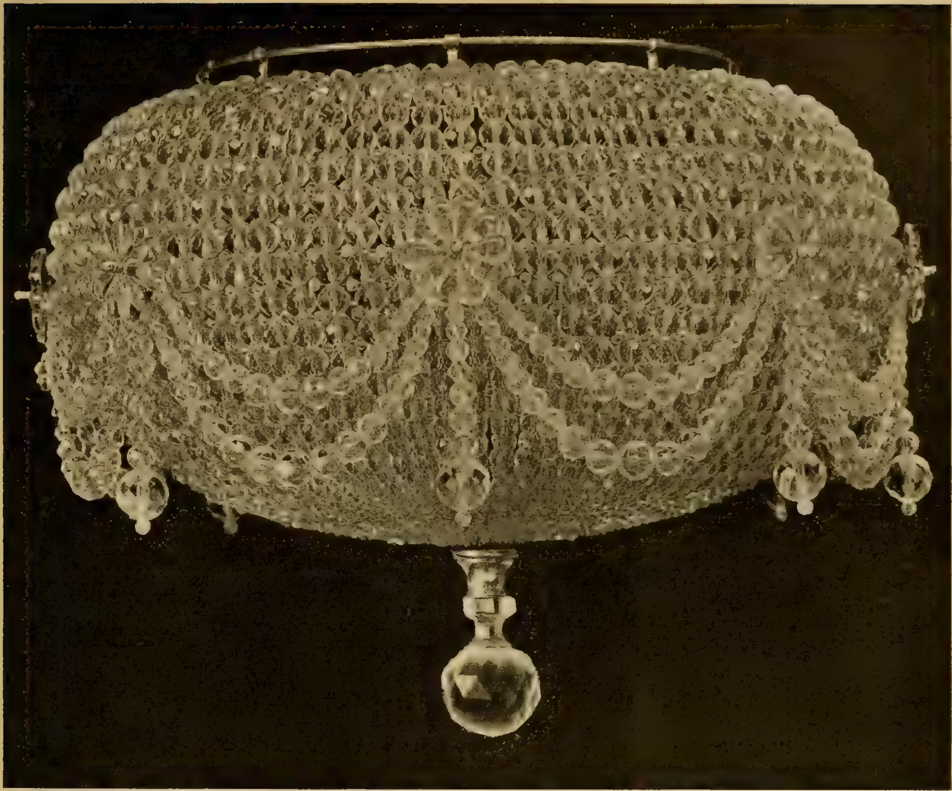
fixture is not such as to bring out its decorative features to their greatest advantage. This is particularly true in the case of metal fixtures; the decorations upon the fixture are thrown into such a shadow, or such effects of light and shade, as to assume an entirely different appearance from what they have under daylight illumination. Strictly speaking, metal is not, under many conditions, a legitimate material for fixture decoration, for the reason that it loses its greatest beauty when the fixture is in use, which is precisely the reverse of what should take place. Glass, on the other hand, fulfills the ideal condition of showing its fullest beauty when the fixture is serving its purpose. By the use of various methods of cutting and moulding it may be given a great variety of decorative forms, all of which are enhanced by the reflection and refraction of light emitted from the sources on the fixture itself.

There is one class of lighting apparatus which does not properly come under the head of "fixtures," and which accordingly forms to some extent an exception to the limitations that apply to them; this includes hand lamps, which are commonly termed "portables." A "portable" is the antithesis of a "fixture." It is always viewed at close range, and consists essentially of but two parts—a support and a shade. The support generally receives very full illumination, and may therefore be treated much more in the nature of a work of art *per se*. In fact, in a certain class of portables the light is actually incidental, being used principally to bring out the artistic elements of the lamp itself. The shades for such lamps are very properly treated as primarily decorative features; but by the use of prismatic reflectors it is a simple matter in many cases to obtain a high efficiency of illumination where required, and at the same time show the incomparable color effects which can alone be obtained by transparency or translucency. A polished shell illuminated from within furnishes one of the most exquisitely beautiful objects imaginable.

It may be interesting to note that, in the manufacture of colored glass, an art which was first developed in Europe and kept as a secret for centuries, America now takes the lead. The best stained glass setters in Europe purchase their finest material in this country. The glass known commercially as "Tiffany glass" stands absolutely without a rival, or even a respectable imitator, throughout the world.

The mistake most common in portables is one which is the more inexcusable, in that it is entirely unnecessary, and that is neglect of the very simple provisions required for giving good illumination. In many cases the light-source is so placed that the shade produces a small circle of light about the lamp, making it necessary to place a book or paper almost directly underneath in order to see to read. Generally also the apparatus is enormously inefficient, due to the fact that the shade is made of colored glass or some translucent material which has almost no reflecting power, and only the natural downward rays (which in the case of electric lamps are the weakest) are utilized. Four 16 c.p. lamps are often used where a single one, with a proper reflector, would give much better results without in the least interfering with the artistic value of either the shade or the lamp.

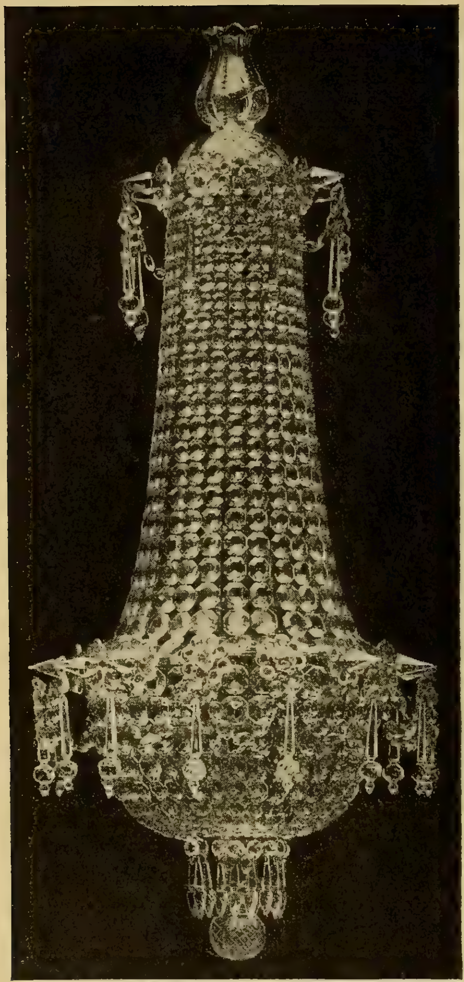
In conclusion, the limits of art in fixture design are comparable with the limits of art in dress: it is easy for either a fixture or a person to be overdressed, and so defeat the very purpose aimed at. The involuntary opinion which should occur to one on seeing a fixture is: "What a beautiful fixture!" not "What a beautiful piece of art metal work." To honestly say, "What a beautifully gowned woman!" is complimentary alike to the woman and to the gown, and is quite a different matter from the expression: "What a beautiful gown on that woman!" The former infers that the gown was made for the woman, and is in harmony with her personality; while the latter considers the gown in itself as the principal attraction, in which case it might be quite as admirable on a lay figure.



# Modern Glass Chandeliers

The use of glass as a material for the construction and decoration of lighting fixtures was developed to a very high degree during that remarkable period of artistic growth which included the reigns of Louis XIV., XV., and XVI., in France. The chandeliers designed for the palaces and chateaux of that period have served as models and inspirations for architects, interior decorators, and fixture designers ever since.

There is a general belief that the art of glass making reached its culmination some centuries ago, but this belief is wholly unsubstantiated by the facts. In reality, glass making in all of its branches is on a far higher plane to-day than ever before. The famous Hall of Mirrors in the Palace of Versailles is archaic in comparison with many a café along the "Great White Way." It will doubtless surprise many of our readers to know that no small number of the glass fixtures supposed to have been made at the time the buildings were put up are modern reproductions. It was found necessary in restoring the buildings to replace portions of the fixtures which had become broken or lost, and in many cases it was found easier to rebuild the entire chandelier than to match up the missing pieces. Of course the design was retained. In this connection, it is interesting to know that glass chandelier ornamentations can be had in France of varying tints to match any of the old pieces. So imperfect was the art of glass making at the time these celebrated fixtures were made that the glass was either distinctly tinted when made or has become so by use. It is in this respect chiefly that modern glass making far excels ancient practice. Glass to-day of the cheapest and commonest sort is of a purity of color, brilliancy of lustre, and permanency of

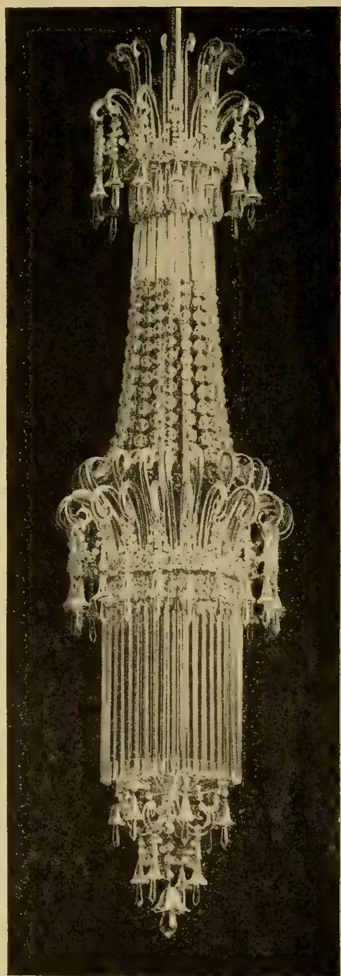


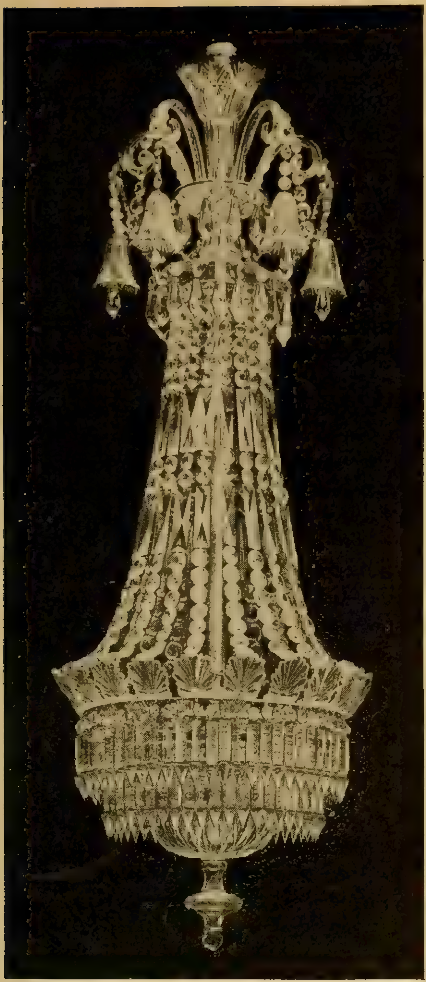
composition that was never attained by the old makers.

Most people are accustomed to think of glass as being perfectly transparent and consequently as having no color. Such, however, is not the case. To the glass maker color is the one most important item. If you will look through any piece of glass so as to get the light through the greatest possible thickness, which you can do by looking at it edgewise, you will observe a distinct tint, either run blue or violet, or a straw yellow. Furthermore, if you will put several pieces of glass of different manufacture side by side, you will also note a difference in tint. The glass used in the French chandeliers referred to is generally of a distinct violet color, but sometimes of a slightly smoky appearance also.

It is another common belief that glass is an absolutely permanent substance. While this is generally true, it is not infallibly so. The writer once saw a common lamp chimney which had dropped down into a sticky purplish-white mass from simple exposure to the air, having "deliquesced," as the chemist would say, by the absorption of moisture, and become decomposed. On one side of the Boston Common there are some old buildings in which the windows are distinctly purple, the glass having taken this hue from exposure to the light.

No better evidence of the skill of the modern glass maker can be adduced than the imitation diamonds and jewels, which, so far as mere brilliancy is concerned, even surpass the genuine. All the numerous brands of near-diamonds are simply pieces of highly refractive glass carefully





cut and polished. In view of the vastly better quality of the glass itself, and the higher degree of mechanical skill available at the present time, it is not surprising that modern glass chandeliers excel in every way, except possibly originality and elaborateness of design, the famous models of the period of the Louises.

One of the most puzzling problems with which the interior decorator and architect has to deal is the designing of fixtures for modern illuminants which shall harmonize with and carry out the spirit of the decorations of former "periods." This difficulty arises from the fact that in these bygone periods artificial illumination was practically limited to the candle. The very presence of an electric lamp and such surroundings is in itself an anachronism. The problem is usually attacked along the lines of least resistance, which is the simple imitation of a candle in a more or less imperfect way. The use of glass chandeliers offers a method of solving such problems well worthy of the most careful consideration. Glass has existed for many centuries, and as material is therefore not incongruous with any period. Furthermore, its use in fixture ornamentations is essentially in the form of jewels, depending upon the brilliant points of light produced by reflection, and the prismatic colors due to refraction and dispersion, for their decorative effect. Diamonds are always in good form, no matter what may be the prevailing style of dress; and the faceted or prismatic glass pendant is equally beautiful and appropriate, no matter what particular period the furnishings or decoration may be in.

A number of illustrations are shown herewith which may serve as examples of what is being accomplished at the present time in the use of glass in fixture design and construction.

## High-Class Fixtures for Retail Stores

The market for fine illuminating fixtures for high-grade retail stores is active in the larger cities. The era of low-priced fixtures is ending among proprietors of fine jewelry, confectionery, drug and fancy-goods stores. In Fifth Avenue, upper Broadway and other fashionable retail streets, a great deal of work in the installation of rich lighting fixtures is going on. In a number of instances fine gold-gilt brackets and chandeliers have replaced low-priced brass tubing fixtures. In Washington, Baltimore, Philadelphia, Boston, Chicago, St. Louis, and many other cities the enrichment of fine retail stores with lighting fixtures made by the very best makers is going on apace. In connection with this subject a representative of The Illuminating Engineer interviewed the managing director of a very large local manufacturing corporation who is renowned for his exquisite taste in the decoration of his numerous establishments devoted to the retail trade. His company has fifty large retail stores in the most fashionable shopping streets in the principal American and Canadian cities, and has 5000 agencies in North America, Europe and Asia. These stores and agencies are all fitted up in accordance with plans and decorative schemes originated at the head offices in this city. The lighting schemes and the designs for chandeliers, brackets, newels, standards, lanterns and special fixtures, and the glass therefor, are especially designed by the corporation's own decorative artists, working in unity with the chief electrical and gas engineer. The result is that these fifty very large retail stores, and the thousands of smaller stores at home and abroad which sell this corporation's products, have an individual style in lighting fixtures, decorations and furniture, as well as in goods displayed.

Indirectly this house has been a large seller of American made gas and electric fixtures, globes, stalactites, electric fans and other goods in the line in foreign lands, because it is known throughout the world as first in its line of products and in the planning and decoration of retail shops. This brings about many orders from abroad for domestic products which the order says must be precisely as made for this important manufacturing concern.

At a neighboring retail drug store the proprietor committed the planning and decoration of the place to one of the highest classed firms of decorators in the country, who sublet the lighting fixture contract to eminent makers. The style throughout this shop is Empire. The brackets, chandeliers, newels and standards are exquisitely wrought and chased, the finish being ormolu. The shades and stalactites are of fine leaded glass, etched with the conventional wreath of laurel designed by the artist David for the arms of Napoleon the Great. The rims of the shades and the bases of the stalactites are beautifully cut. An eminent electrical engineer planned the number of lights and the disposition of fixtures, so that the lighting effects are both scientifically correct and very effective as an exposition of fine art in illuminating fixtures.

The high-class retail druggists are also in the upward movement for the installation of the best grades of illuminating fixtures. The proprietor of a chain of very fine retail drug establishments recently expended $8000 for the illuminating fixtures in a local shop, 25 feet by 90 feet. The three five-branch brackets in the front window are Louis XVI., finished in matt gold, with cut glass bobeches and imitation candles for electricity.

These and other superbly lighted retail shops of the higher classes are serving as examples for many others to follow. The representative of The Illuminating Engineer who has studied these installations is informed that within six months one fine retail confectionery and ice cream shop to be opened in Fifth Avenue will spend $20,000 for gold-gilt chandeliers and brackets, with cut glass shades and stalactites.

A famous bakery that is moving up town will spend $28,000 for illuminating fixtures, grille work, rails, etc., with a firm of lighting fixture makers. In this installation the interior of the wall and floor showcases will be inset with miniature incandescent electric lamps placed in metal roses, lilies, morning glories and tulips. The metal finish will be in rich particolored enamels, as used in the manufacturing jewelry trades.

## The Evolution of a Modern Fixture Manufactory

"The butcher, the baker, the candlestick maker" were formerly classed together as craftsmen of equal skill. The modern fixture maker, of whom the candle-stick maker was a prototype, has progressed a long way beyond such a classification, and is to-day an artisan of the first rank. The following brief account of the evolution of a prominent fixture house shows what progress has been made within a single generation.

"My evolution into the making of gas and electric fixtures," said the president of an important corporation that covers a very large field of work in metals, "was a slow process. I was fifty years progressing from the making of brass oil-can spout-tips and tops to high class gas and electric fixtures. I began with a foot lathe in a small shed. My products were sold to men who made tinware for the old-time commercial missionaries of New England, the tin peddlers, whose red wagons went as far west as Chicago and as far south as New Orleans.

"My next step was the making of small brass hand lamps, fitted for wicks, used without chimneys. In those days, hotels and boarding houses used nothing else for guests' rooms. Each person on going to bed was handed one of those little lamps, which smoked and flared and emitted offensive odors just about long enough to allow the user to undress. Candlesticks died hard. For years I made many more candlesticks and perforated tin and brass lanterns for candles than lamps and lanterns for camphene, rosin and whale oil.

"As kerosene became a safe and low-cost illuminating product, I embarked in making kerosene lamps and lanterns; and as farmers became prosperous and went in for fine house fittings, I began to make kerosene hanging lamps, chandeliers and brackets. A few years ago this art reached a high plane. Makers of kerosene lighting fixtures made very much more output than the gas fixture interests. In fact, we looked on our friends in the gas fixture business as pretty small potatoes in output as compared with our trade.

"I had never heard of an electric lighting fixture up to 1881. In that year I went over to New Britain to attend a wedding, and was introduced to a very likely young man who told me that he was working on a new-fangled electric light, which he thought would be developed into an industry which would require many millions of dollars' worth of fixtures a year. That interested me. I mentioned what the young man had said, later on in the evening, to a venerable hardware maker. He said: 'The young man has good natural parts, and means well, and is hard working, and very much of a gentleman; but he has too much book l'arnin' —one of them eddicated fellers that has no gumption. I keep a-tellin' him to drop the tarnation crazy fol-de-rol electric light that won't never amount to nuthin', and go in for somethin' sensible like. But he is as pig-headed as anybody I ever see in all my born days.' I afterward invested $250,000 in an electric company headed by that young man, and it has been a good thing for me in every way.

"Time rolled on, and in the late '80's and the early '90's friends came to me and wanted me to make electric fixtures. But I declined, as the demand for kerosene fixtures was constantly increasing. In the late '90's my travelers West and Southwest began to fall off in their sales of fine kerosene fixtures, and all reported that the tremendous development of the electric lighting industry was killing the market for kerosene fixtures. In the meantime almost everybody in my line had spent lots of money trying to distribute kerosene from a tank in the upper part of a building through pipes, like gas pipes, into chandeliers and brackets. It was no go; not one of the inventions worked well. Finally, the kerosene fixture line, except in low-priced goods, declined so much that, in order to find work for some of my best hands, I branched out into gas and electric fixtures; and lo, and behold, back to us came hundreds of old customers in the West and South who had gone from kerosene goods into electric fixtures all through the rich agricultural districts. So far, we are not doing much in working up fixture sales in the large cities; we have all we can do in the West and South. The business is growing rapidly. Export trade in kerosene goods is increasing, but home trade is not what it was years ago."

## "Competitive" Designs for Fixtures

The amount of capital invested in drawings used by gas and electric fixture makers in the solicitation of orders is large. The stock kept by a local manufacturing house, whose work is chiefly done for very rich persons, is estimated at $50,000, based upon the actual outlay for the time of designers and draughtsmen. Another local house estimates the cost of its drawings kept for the use of salesmen at $35,000. A manufacturing concern whose stock of drawings for displaying before prospective customers does not average at least $25,000 in actual cost, is of little importance in the trade.

For special competitions for costly public and private buildings, fixture makers are often called upon for colored drawings made to the actual dimensions of the proposed fixtures. This is in most cases a rank imposition upon a body of men whose profits, owing to keen competition, are cut very close to cost, and upon whom the demand for full sized drawings for a large undertaking comes very hard. A few days ago one of the most distinguished designers in this line of work exhibited to us a lot of full-sized colored drawings, submitted in an alleged competition for an important building. The cost of the drawings was $3,500. The designer had no hope when he turned in the drawings, as the story had gotten about in the trade that the order had been prearranged for certain persons—an occurrence not unprecedented in the trade. This designer, being suspicious of the matter, tied the drawings with a peculiar knot. When the drawings were returned from the "competition," it was seen that the knots had not been unfastened. In that alleged tender for specifications a dozen fixture makers appeared with the required costly and special designs, which in the aggregate cost upward of $40,000. The supposition that these drawings may be used time and again is based upon a weak foundation. It is not considered politic in the trade to submit for the competition arranged by B the designs which failed to meet with the approbation of A in a recently closed competition. Architect Gargoyle frowns upon fixture makers who lay before him designs which won Griffon's competition for the Hotel Astorbilt, or which failed to satisfy Groin and Mullion in their specifications for the Church of St. Dives the Millionaire, or which came within an ace of winning out in the competition which Messrs. Caisson and Concrete arranged for the Tower of Babel office building.

In all fields of decorative art certain designs which have been in use for centuries are in daily use in sketches submitted to architects. But in the illuminating fixture business, the opinion of many architects, decorators and real estate owners is that the fixture designer is a perennial fountain of new ideas which he cannot help from bubbling over every day in the week, which are novel in design and stunning in effect.

In almost everything that is beautiful in his interior and exterior work in structures the architect is a debtor to the geniuses of remote centuries; but in the matter of lighting fixtures he, in almost all cases, is not satisfied unless there are strikingly novel designs and effects. One of our greatest architects—and a good and brilliant man to boot—always set forth his ideas for illuminating fixtures in this way to his old friends in that line: "I do not know what in blazes I want, boys; but you may take it from me, it's got to be something mighty scrumptious. The owners, as you know, are mighty up-to-date people, who know what the real lum-tum things are. You just pull your thinking caps on right down over your eyes, and get the thinks a-coming right quick."

Most of our architects have about the same thing to say to illuminating fixture designers. The good effect therefrom is the enormous amount of really good work to the credit of American designers; the unsatisfactory result is the tremendous costs assessed upon fixture makers for the daily output of drawings, most of which are prepared with the care given to water colors to be hung in drawing rooms.

# Theory and Technology

## Light Versus Dark Symbols in Printing

By Nelson M. Black, M.D.

Albert J. Marshall, in his article "Light Versus Dark Symbols in Printing" (*Illuminating Engineer,* January, 1908), states, "The eye sees an object when the light rays are reflected from the object to the eye," and that, "in reading a newspaper, for instance, or any other printed matter, which has black letters on a white surface the eye "sees" by the amount of light rays which are reflected from the page as a whole, and not the amount of light rays which may be reflected from the print."

"In other words, the eye is compelled, in order to read a printed word in dark ink on a light surface to receive the reflected rays from everything other than that it desires to see, and by so doing is tired and strained."

Also that, "it is rather amusing to note that oculists, to whom we expect to look for advice in such matters are numbered among such offenders in that the cards that they use in 'testing' the eye, have these same old black letters and numbers on white back grounds."

The first statement is true; visible objects are seen by virtue of the light they reflect, and in order to distinguish one from another they must have different forms, and there must be a difference in the amount of light they reflect to the retina: in other words, we are enabled to see objects illuminated by reflected light only by reason of the contrast between the intensity of the light reflected from the background and the object fixed.

The object fixed on a page is the printed word, not the strongly illuminated area between the words. It is, however, certainly true that where the coefficient of reflection from a surface is high, such as that from a glazed white surface the tiring of the eye is more marked. The coefficient reflection in such an instance is in the neighborhood of 70 to 75 per cent. of the incident light, while in the ordinary newspaper the reflected light is nearer 40 per cent., and more thoroughly diffused, because of the rough surface of the paper.

Mr. Marshall remarks, "the eye is compelled, in order to read a printed word in dark ink on a light surface to receive the reflected rays from everything other than that it desires to see, and by so doing is tired and strained," practically stating that it is the reflection from the light surface which the eye fixes instead of the object looked at.

If such is the case, how much more will the eye tire, if the object fixed has a greater coefficient of reflection than the surrounding background? The condition may be compared to the tiring of the eyes from incandescent lamps in the line of vision when used in a room with dark walls: this tiring is hardly noticeable in a room with the walls of a lighter hue.

Mr. Marshall calls attention to the general tendency to use dark background and light lettering on large display signs. This is done simply to attract attention. The sign is read and the eyes directed elsewhere. I don't think any of us could gaze very long at such a sign without eye fatigue.

Dr. Geo. M. Gould advocated "Test

cards, with black background and white letters," in 1897, maintaining they were correct, basing his assertion upon the physiological principle that, "white surfaces reflect all or a larger part of the light thrown upon them, and this light stimulates the retinal elements upon which it falls. Conversely black surfaces absorb the light and consequently rest the retina."

The fact that very few are now in use at the present day indicates that his surmise was not correct.

There are several factors which seem incompatible with the use of white letters upon a black background:

1. Dark characters upon a lighter background have been used from time beyond recall, and the human eye has become adapted to this condition.

2. The irradiation from white characters upon a black background is marked, making the characters, it is true, appear larger, but much less sharply outlined.

3. Luminous points or small brightly illuminated area tire the eye much more than dark areas surrounded by brighter ones.

4. There is always the production of disagreeable after-images which are confusing.

I have time and again tried out patients to determine which was the most restful to their eyes during an examination, and with which they obtained the best vision: black characters on a white ground or white characters on a black ground: invariably the decision has been in favor of the black letters on white or, better still, black upon a pale yellow or tan.

A few moments' comparison of charts with white letters upon a black background against charts with black letters upon a white ground, both having the same illumination, will quickly convince the most skeptical which is the most comfortable to the eyes.

# The Illumination of Shady Streets

By A. R. Dennington.

The criticisms of Mr. Thurston Owens on the article dealing with the illumination of shady streets are interesting and instructive, as in any matter not susceptible of mathematical proof an honest difference of opinion is often advantageous in bringing out desirable features and presenting new points of view.

The use of prismatic reflectors on mantle gas burners for street illumination is, according to Mr. Owens, not only unnecessary, but undesirable because of the loss of light due to absorption. I would call attention to the fact that any thoroughly satisfactory diffusing device is not a source of loss, but by redistributing the light rays which would ordinarily be useless, the effective illumination is increased even though the total radiation from the source is considerably reduced. The use of a diffusing globe or shade on an inverted mantle burner would be less efficient than on the upright burner because the natural distribution from the former type of mantle is more suited to the required conditions, but in either case use of a properly designed globe or reflector should improve the quality of the illumination.

In the matter of light distribution, I cannot agree with the statement that the roadway should be more brilliantly illuminated than the walks. The argument that the driver of a rapidly moving vehicle requires more aid from the street lamps than the pedestrian is hardly valid, as all rapidly moving cars and carriages are provided with headlights, which break up any shadows cast on the roadway and give a clear view of the street for a fair distance ahead. On the other hand, it is important that the sidewalk be uniformly illuminated so a pedestrian can see and avoid any inequalities in the surface. In wet weather shallow pools of water form in the depressions, and if the walk is a hit and miss combination of light and shadow it is impossible to locate the dry sections, except by trial, and this method is at times inconvenient. The aim should be, of course, to furnish satisfactory illumination to all parts of the street, but if shadows must be thrown on any part of the street it appears to me that they will give less

annoyance if thrown on the roadway than if thrown on the walk.

In the considerations of expense, I can agree with Mr. Owens that the incandescent system will be somewhat greater than that of the arc system, and I admitted this point in my article, but it would seem that the estimates of the cost of the incandescent system, as given by Mr. Owens, are high. In estimating the cost of any system of lighting, it is necessary to consider the initial expense of the installation, and this will of necessity be greater for incandescent street lighting than for arc lighting. If each arc is replaced by eight 40 c. p. 50 watt lamps, the saving in energy will be about 200 watts for each equivalent arc, as a 5.5 ampere 110 volt arc requires about 600 watts. The maintenance cost of the eight incandescents would scarcely be greater than the maintenance cost of the arc, so the saving in cost of energy could be used to help pay the interest on the added investment.

Tests have shown that it is possible to construct metallic filament lamps having a useful life of from 1000 to 2000 hours. At the present time, in order to meet the demand for lamps, the manufacturers are crowding their factories and the product may not be as satisfactory in length of life as it doubtless will be when the process of manufacture has been further perfected. Renewing lamps twice each year would be sufficient for an installation operating on the standard moonlight schedule, provided each lamp could be depended upon for a useful life of about 1100 hours, which is not unreasonable.

The statement made in my article regarding the use of flaming arcs with clear glass globes referred particularly to the magnetite type of lamp, which is often furnished with a globe having the lower portion sandblasted and the upper portion clear. The rays emanating from the arc in a nearly horizontal direction are not subdued or diffused, so this style of globe is open to the objection that the intense radiation from the arc may enter the eye of the wayfarer and serve only to intensify the blackness.

# Recent Progress in the Voltaic Arc

By Isidor Ladoff.

(*Continued*)

The latter patent necessitates that a conducting carbide or oxide is to be used. The heating must be conducted with exclusion of air, and therefore in a vacuum, in an indifferent gas or imbedded in carbon. When the filament is to be made of an alloy besides vanadium, niobium and tantalum, there may be used another metal or metals, such as thorium, zirconium, and the elements of the ytteric group, ytterium, erbium, sebium, gaddinum, and samarium, all of which have a very high melting point.

The British patent No. 10,241 was issued in 1899 to Oliver Imray. This patent claims the following improvements in the manufacture of incandescent filaments:

1. In the preparation of filaments wholly or partially consisting of osmium for electric lamps, the process of taking all or nearly all the occluded gas out of the filament in a vacuum at a white heat.

2. Osmium filaments for electric incandescent lamps containing small proportions of carbon or hydrocarbon.

3. Compound osmium filaments for incandescent lamps containing a proportion of zirconium, thorium, niobium, tantalum, silicon or metals of similar behavior or of the rare earth metals.

4. A process for the manufacture of the illuminating filaments from oxide-osmium filaments, characterized by having the oxides of the filaments partially reduced in a white heat.

5. Compound osmium filaments for incandescent lamps containing the substances mentioned in the preceding claim wholly or partially in an oxidized state.

6. In the preparation of filaments for incandescent electric lamps of osmium and osmium alloys the process of formation by long continued glowing in a partial vacuum.

7. The preparation of filaments consisting of osmium and the substances referred

to in Claim 3 by the partial or complete reduction of the oxides by means of carbon or of the gases occluded in the osmium itself.

8. In the manufacture of filaments for electric incandescent lamps, in which oxides are present, the process of heating them in a vacuum or any suitable gases below the temperature of reduction of the oxide filament until the occluded gases are driven out prior to heating them to the temperature necessary for the reduction of the oxide.

9. Filaments prepared by the processes herein described and claimed with or without an external covering of resistant oxides.

A United States patent, No. 633,350, was issued in 1899 to O. M. Thowless. This patent contains the following claims:

1 A burner for incandescent or glow lamps composed of an internal basic filament or strip covered with a layer of non-conducting material and a light-giving surface deposited thereon.

2. A burner for an incandescent lamp of a basic non-conducting filament having a loosely-fitting conducting covering, designed to serve as the light-giving portion of the burner.

3. The method of making burners for incandescent lamps, which consists in properly preparing the surface of an internal non-conducting core, solid or hollow, for receiving a layer of electrically deposited carbon, and then submitting the burner so prepared to the action of the flashing or other similar process.

4. A burner for incandescent lamps, consisting of a hollow tube or cylinder of non-conducting substance covered with a layer of conducting material.

5. A burner for incandescent lamps, consisting of a hollow internal filament or strip, a coating of non-conducting substance, and a layer thereon of conducting material.

6. A burner for incandescent lamps, composed of a properly-prepared non-conducting base, and having for its light-giving portion a composite material composed of a mixture of conducting and poorly-conducting substances.

7. A burner for incandescent lamps, composed of an internal filament, a layer of non-conducting substance and a covering of composite conducting material.

8. A burner for incandescent lamps, composed of a hollow non-conducting base covered with a layer of composite material formed of a mixture of conducting and non-conducting substances.

The idea of improving the properties of ordinary arc light carbon pencils by the addition to the mass of these pencils by the various mineral substances does not represent anything new. Casselman (Poggendorf's Annelen, 1844, vol. 63 introduced into electric carbons borates, sulphates and boric acid.

In order to lengthen the life of the carbon pencil, Wortley (French patent No. 129,636, 1879) adds silicates to the paste. Lacombe (French patent No. 509,170, 1890) adds to the same sulphates, chlorates, phosphates, etc. Boric and phosphoric acid are added to the carbon paste for the same purpose by carbon manufacturers. Mignon and Rouart (No. 143,206, 1881) claim a vitrified exterior coating. Julien (French patent No. 265,661, 1896) recommends the same process with the addition of silicates, tungstates, the salts of lime, magnesia, soda and potash.

More than a quarter of a century ago (1876) Gaudin, Carre (1886) and Archerau (1878) in France discovered the property of mineralized carbon pencils, especially the properties of carbon pencils to which limestone, magnesia and similar substances were added. In the same manner numerous researches have been made with various components, such as carbides, oxides, fluorides, etc., of different metals. Du Moncel, in his treatise of 1883 on this subject, reports that so far nobody knew how to apply these lighting properties of mineralized carbon in a practical fashion, on account of the formation of slags and the instability of the arc.

Carre (1886, French patent No. 174,-268), namely, recommended the addition of a half per cent to ten per cent of the carbonates, borates, or acetates of sodium, potassium or barium, or boric acid, as we have seen. Wortly, in 1879, indicated the addition of one to one and a half per cent of magnesium silicate. Lacombe (1890) advised the addition of sulphates, chlorides, phosphates, phosphoric acid, etc. Nobody advised the addition of any substance to the mass of the carbon more than in the proportion of two per cent.

*(To be continued.)*


## Illuminating Engineering and Electrical Contracting

When you read in the advertisement of an office building or residence: "All modern conveniences," what do you expect to find? You would probably first think of the plumbing, and expect to find the installation in strict accordance with the most modern ideas as to convenience and sanitation. You would expect to find an abundant supply of water, probably both hot and cold, and, in many cases, it would not be unreasonable to expect a special supply of pure, cold water for drinking purposes. You would also expect to find steam or hot-water heating devices, suitably installed, and probably a system of ventilation. If it were a residence, you would expect gas, and suitable arrangements for its use for heating and cooking. And lastly, you would probably entertain some faint hopes that there would be a means of lighting up the place at night so that you could use it for its required purpose without going prematurely blind.

The chances are a hundred to one that you would find all of these "modern conveniences," except the lighting, up to your expectations. If you went entirely on your past experience, it is not unlikely that you would find the lighting up to your expectation, having learned to expect mighty little in the way of this convenience.

We have learned how to heat and ventilate, and how to provide the sanitary requirements of a building almost to perfection within the past ten years; and if it is any satisfaction to your patriotism to know that America is fifty years ahead of any other country in this respect, you are entitled to the comfort. We are just beginning to commence to learn how to properly light buildings, and it is altogether probable that the next ten years will see as great progress in this utility as the past ten years have seen in plumbing and sanitation.

Adequate lighting installations—that is, installations laid out with the care for the efficiency and quality of results that is shown in the construction of other utilities —are still the exception rather than the rule. But everything must have a beginning; and Illuminating Engineering is now in its nascent state.

There are an enormous number of lighting installations of old, or even recent construction, that will have to be entirely remodeled in order to be classified as "modern conveniences"; and it is by no means uncommon for the electrical contractor to be called in to do makeshift wiring in an entirely new office building before its occupancy. The public is being rapidly educated up to a point where it demands that the illumination shall be on a par with the other conveniences. It does not know just how this is to be accomplished, nor is it particularly concerned with the "how." The tenant of an office building is no more expected to be an illuminating engineer than he is to be a plumber or a steam fitter; but he is getting to know the difference between good and bad lighting; and to know the difference is to demand the good.

The remodeling of old installations will be largely in the hands of electrical contractors, and the opportunities for building both reputation and business profits by an intelligent application of illuminating

engineering principles are almost beyond compute.

We recently inspected a club house in this city, put up only five years ago, in which the lighting installation is being entirely remodeled, as a matter of economy in general, and of absolute necessity in certain rooms, for the sake of better results. The electrical contractor who could have laid out a plan for the necessary changes, guaranteeing results as to efficiency and quality, would have received the contract and a vote of thanks; and this is only one of innumerable cases.

The electrical contractor should not wait for such cases to come to him, but be on the lookout for them himself; they are surely easy enough to find. But in order to get them the contractor must be sure that he can improve things materially, and show his own conviction by a reasonable guarantee. Illuminating engineering is a science upon which guarantees as to results may be based with as much certainty as in any other branch of constructing engineering.

The average citizen has a deep-seated notion that the electrical contractor's primary purpose is to string up as much wire as his client will stand for, regardless of efficiency in results. He stands as a sort of urban reincarnation of the lightning-rod agent who flourished in the rural districts a generation or two ago. This opinion, erroneous though it may be, must originally have sprung from some due cause; that it is prejudicial to the best interest of both contractor and client there can be no doubt. An honest application of the principles of illuminating engineering affords a most happy opportunity for the electrical contractor to uproot this prejudice, to the advantage of all concerned. The time to do this is right now. The light will be required when the dark days come in the fall, but the time to do the remodeling is during the summer, when the lights are not so imperatively needed. The old story of the man who could not shingle his house when it was raining, and did not need to shingle it when it was fair, points a moral to the merchant or landlord who will not look to his lighting installation during the summer, when it is least needed.

A constructing illuminating engineer was just now telling us of some of the new contracts that he had received for remodeling. "Then you do not find the summer so dull a season in lighting?" we queried. "No," he replied, "I have never found much difference; the only 'dull season' for me is when I do not hustle for business."

There is at least $50,000,000 worth of constructive illuminating engineering—or perhaps it were more correct to say *reconstructive*—in urgent need of being done this summer. How much of this are *you* going to do?

## The Last Word in High-Efficiency Incandescent Lamps

The revolution in electric lighting, which began commercially with the introduction of the so-called "metalized," or "gem" filament, and progressed in rapid stages from the increase in efficiency of 20 per cent. represented by this improvement, to 33 per cent. in the tantalum lamp, and 66 per cent. in the tungsten lamp, has not yet reached its final stage; and what the final outcome will be no one can predict at the present time. The one thing already assured is that the carbon filament is doomed to disappear. It is fairly safe also to prophesy that, in the final stage, solid filaments of all kinds will disappear, and gas or vapor take their place as the luminous element.

Just as the tungsten lamp is fairly launched on its career another lamp claiming at least equal efficiency and numerous valuable additional properties is announced for an early appearance upon the commercial stage. This lamp is new even to its name—Helion. This name, which is of Greek origin, as might be expected in view of the fact that one of the co-inventors is a college professor, is intended to signify that the light emitted is like sunlight in color value.

The method of producing the filament is extremely simple, consisting merely of subjecting the ordinary carbon filament to the action of a gaseous compound of silicon, by which the carbon becomes coated to any desired thickness with the latter element. Apparently some combination between the two substances takes place, the exact nature of which even the inventors are not yet fully conversant with. The result is a substance of practically fifty times the resistance of carbon and 300 times that of tungsten, thus requiring

the use of a shorter and thicker filament, and consequently one of much greater mechanical strength. Herein lies its greatest advantage over the tungsten filament, which in the best form thus far produced is exceedingly fragile, and of such low resistance as to require a comparatively great length, even for the lower voltages.

The higher efficiency of the Helion filament is principally a matter of higher temperature, as in the case of the tungsten filament, although the inventors claim some advantages in the way of selective radiation. The Helion filament is not readily attacked by oxygen, and the inventors have lately shown that it can even be mainatined at incandescence in the open air for a considerable length of time; consequently these lamps will not require the extreme high vacuum that has been essential in the carbon filament lamp, which will slightly decrease the cost of manufacture.

Instead of using a rare metal which is difficult to produce, as in the case of tungsten, the Helion filament uses two of the most plentiful elements of the earth—carbon and silicon; and at least so far as the theory goes, the process of their utilization is extremely simple.

If the inventors have overcome the mechanical difficulties of the problem, as they claim, it would seem a foregone conclusion that the tungsten filament will have as brief a career as its immediate predecessor, the tantalum filament. The claims put forth for the Helion filament, if substantiated—and there is no particular reason to doubt that they will be—will produce a lamp superior in most respects to any that has previously been put upon the market.

Truly this is the transition period in electric lighting. You can never be quite sure when you turn off your latest form of electric light at night whether it may not be a "back number" in the morning.

## A New Selenium Photometer

Under date of May 26, 1908, a patent was granted to W. J. Hammer on "a method of measuring light." The substance of his claims is summed up in the specifications as follows:

"I am not aware of any existing method of measuring light in which an ascertainable physical quantity is caused to vary by means of light, and the extent of the variation, being capable of direct measurement, is used as a standard of comparison: and to this feature of novelty I desire to make broad claims."

There is an adage among patent lawyers to this effect: "Claim everything in sight and get all the patent office will allow." The broad claim made by Mr. Hammer, as stated above, seems to have accomplished this purpose to the limits in both respects. To claim a method of measuring any variable by the measurement of some other variable having a definite relation to it, is nothing more nor less than claiming the basis of all physical measurements. Could this claim be maintained, Mr. Hammer would have a monopoly on mensuration. Instead of being new, however, the principle enunciated is as old as natural science itself. The specific application of the principle which it is sought to especially cover in this particular patent is also old, at least in principle. Briefly put, the system of measuring light as described consists in measuring the change in resistance of the so-called selenium cell when subjected to light of various intensities.

On page 119, Vol. 1 (April, 1906, issue) of THE ILLUMINATING ENGINEER will be found an article entitled: "Selenium and Its Uses," in which, among the various ways in which this peculiar property of selenium may be utilized, is the following:

"Selenium was used in 1875 by Werner Siemens in the construction of a selenium photometer, but at that time the metal could only be prepared to be sensitive to the red, orange and yellow rays.

"M. Ruhmer, in *L'Eclairage Electrique*, October 14, 1905, describes a photometer and radiometer for Röntgen rays, in which he makes use of selenium specially prepared for this purpose.

"The selenium element is placed in series with a battery and a milliammeter, the reading of which increases or decreases in a manner exactly analogous to the intensity of the photographic and therapeutic effects."

On page 475 of Vol. 1 (August, 1906, issue) is an article entitled: "Selenium and Its Importance in the Gas Industry," by H. Raupp, which is an abstract of a paper read by the author before the Association of Gas and Water Engineers, Mainz, Germany. In this is described a so-called

selenium cell consisting of a filament of selenium wound around a porcelain cylinder contained in an ordinary incandescent bulb, and connected so as to screw into the ordinary lamp socket. While it is not specifically stated in the description, the inference is plain that the lamp bulb is exhausted. In order to use this for photometric purposes the writer connects it up in the usual manner with a battery and galvanometer, but instead of measuring the electrical variation, the writer prefers to use this variable as a constant and measure the light intensity by the more familiar method of varying the distance of the standard and the measured light-source from the selenium cell.

The use of selenium as the basis of photometric measurement would therefore seem to date back at least to 1875. That a claim for novelty on the application of the selenium cell to photometry should be made by a man of the experience and scientific attainments of Mr. Hammer is astounding, and the fact that the patent office would allow as a claim "the new art of measuring light which consists in causing the light to be measured to vary an ascertainable physical quantity, and measuring the extent of the variation" is even more astounding. The very basis of the patent law is that a physical law or principle cannot be patented, but only a specific means of applying such laws.

So much for the matter of patents. Now, as to the merits of the instrument itself. If Mr. Hammer has succeeded in eliminating the uncertainties of the selenium cell—and he has undoubtedly made valuable progress in this direction—at least, there would seem to be many advantages to be gained by the practical use of the well-known principle involved. In the specifications of his patent Mr. Hammer refers to the inaccuracies and errors that arise from measuring light by visual perception, as carried out in the present form of photometers, but in the same specifications describes the method of calibrating his proposed photometer by the very methods he decries; so that, after all, it is based on visual perception; as in fact all photometers must of necessity be, for light, so far as we are concerned with it in illumination, is a sense perception. The errors, however, in this case, would be reduced to a minimum, since the instrument could be standardized by a single observer under the most favorable conditions. Having been once calibrated, assuming that the idiosyncracies of the apparatus, or in common parlance "the bugs," have been practically eliminated, actual measurements could be made with great rapidity and accuracy. It must not be overlooked, however, that the instrument must be calibrated for every different source of light, since the effect upon the selenium element does not necessarily vary with the visual intensity of the rays.

There is a possible application of this principle which we wish to point out, and which, so far as we know, is new, but upon which we have no desire to claim a patent monopoly. This is the construction of a photometer which shall integrate luminous intensity with time. Theoretically at least, light can be sold as a quantity only when the time element can be measured in connection with it. The common measurement of intensity is analogous to the measurement of the voltage of an electric current; the measurement of mean spherical candle power is similarly equivalent to the measurement of wattage; but as yet the instrument has not been devised which will give a measurement analogous to watt hours, that is, candle-power hours. Why should not a recording volt meter be used in Mr. Hammer's proposed photometer which would thus convert the instrument into a candle-power-hour meter? We outlined the theory of such an instrument to Mr. W. D'A. Ryan more than a year ago, who agreed that the theory at least was sound. If such is the case, the candle-power-hour meter is bound to sooner or later become an accomplished fact. Light can then be bought and sold as a commodity in a manner exactly analogous to the sale of electric current at the present time.

## White Versus Black Letters in Printing

In order to come to a sound conclusion from a purely theoretical course of reasoning we must be sure that we have taken all the facts into consideration. Mr. Marshall, starting from the easily recognized fact that the printed surface of paper is much less in area than the unprinted part, came to the conclusion, from a perfectly logical process of reasoning, that it would be better for the eyes to re-

verse the prevailing practice and have printed matter formed by light letters on a dark ground. As in all cases of theoretical reasoning on scientific subjects, the advice "try it" is always in order.

We gave our readers an opportunity of trying Mr. Marshall's conclusion in the last issue, and we have not the slightest doubt that the unanimous opinion will be that the old style of black letters on white ground is incomparably easier on the eyes than the reverse method. The explanation for this, in spite of the sound reasons from Mr. Marshall's single premise, are very clearly set forth in a communication from Dr. Black, appearing in another section of this issue.

Of the several reasons given, the one referring to irradiation undoubtedly is of far greatest importance. Irradiation is the result of an abnormal action of light upon the retina, and is familiar to every one in the enormous apparent increase in size of the filament of an electric lamp when emitting light. It is a purely physiological phenomenon, due to the spreading of the stimulating effect of the light, whatever that may be, beyond the limits of the retinal image. It is analogous to the spreading out of ink on soft paper, which has the effect of producing a blurred outline. It is this indefinite, blurred outline of the white letters that makes them so much more difficult to read than the black letters. This spreading, or irradiation, would of course be reduced by reducing the contrast, which could be accomplished by using a tinted paper, say of a light yellow or cream color, in place of white, but it is doubtful if this expedient would produce a result on the whole as satisfactory as the present method.

We referred to the fact that the suggestion had been made by the paper manufacturers for commercial reasons, and suggested that the chief difficulty in this regard would be the production of a satisfactory white ink. An inventor and scientist of wide reputation has written us that he experimented several years ago upon a means of producing white or light-colored letters upon a dark-colored paper by an electric process, without the use of any ink whatever, and states that the method could undoubtedly be worked out to a practical success. Incidentally, it may be said that electricity will probably some time take the place of ink in printing.

## Convention of the International Acetylene Association

The next convention of this association will be held in Chicago, August 10, 11 and 12. While the full programme of papers and entertainment has not yet come to hand, there is no reason to believe that these two attractions of the convention will be such as to do credit to the association and justify all members and others interested in this particular branch of the lighting industry in making the trip.

Acetylene has thus far occupied but little of the time and attention of illuminating engineers; but this is due to a number of causes peculiar to the general lighting situation and not to any lack of appreciation of its real importance as an illuminant. The occupation of illuminating engineers thus far has been chiefly in the nature of an emergency service—a sort of "first aid to the injured"; and the electric light has therefore held the center of the stage. Our electrical friends themselves must admit that, while the electric light offers the greatest opportunities for varied and useful purposes, it likewise offers equally great opportunities for bungling and misuse, and the latter have been taken advantage of to the limit.

The acetylene lighting industry has had the misfortune to suffer more from prejudice and ignorance than any of the other modern illuminants. Prejudice is born of ignorance, lives long and dies hard; like the poor, it is always with us. While the common fallacies regarding acetylene have been to a considerable degree overturned, there is still much to be done in this direction before acetylene can take the place to which it is entitled in the lighting industries. There are still many intelligent people to whom a suggestion to put an acetylene plant in their buildings would be received with the same sort of a nervous chill that they would suffer if requested to store dynamite in their cellars, notwithstanding it has been conclusively proven time and again that with our present knowledge of its properties and the proper methods of handling it, there is no more danger from acetylene than from ordinary illuminating gas or kerosene oil—probably not as much as from the latter. It is curious, but true,

that in a recent fire a tank of compressed acetylene was the only thing that came through without injury.

The association should be able to do much in removing this common ignorance and prejudice. The manufacturers of carbide have certainly done their share in a very commendable manner, but no matter how sound their arguments or uncontroverted the facts which they may present, they carry with them the suspicion of self-interest, which would not attach to arguments and facts presented by a dignified body of men like the Acetylene Association.

There is no danger of getting too many good illuminants; the more the merrier. The legitimate field for acetylene lighting is extremely large, extending to every household which is beyond the distributing lines of a well managed gas plant or central station, and to the public lighting of innumerable villages and small towns.

The association has great opportunities, but the extent to which these can be profitably used will, of course, depend upon the energy with which those who are particularly interested in the acetylene industry devote to its promotion.

The association should have a far larger membership than it has at present. Just how this increase in membership can be secured is a matter to be determined by the association itself, but a special effort to make the coming convention a record breaker in attendance and interest would certainly be one of the most effective means.

## The National Electrical Contractors' Convention

Coincident with this issue, the National Electrical Contractors' Association will be in annual convention in Chicago.

The association and its purposes are in every way commendable, and should work together for the good of both the contractor and his clients. One of the chief purposes of all commercial organizations is the elimination of illegitimate competition, and in this purpose the public have as much at stake as the tradesman. When competition reaches this point it becomes the bane of business rather than its life.

We have previously referred to the opportunities which practical illuminating engineering offers to the electrical contractor for expanding his business; and the rapid progress in the improvement of electric lighting devices has increased these opportunities. It is a self-evident fact that the consumer of electric light is not going to continue using a form of lamp which takes three times the current of the improved forms for any great length of time after he has become aware of this difference. The change in almost all cases will mean a general remodeling of the lighting installation. The new lamps are of higher total candle power, and generally used in conjunction with special accessories designed to utilize their peculiar light-giving properties to the best possible advantage. In order to properly remodel such installations, however, in accordance with modern demands, requires a knowledge of and compliance with the principles of illuminating engineering. The electrical contractor who expects to retain a reputation for satisfactory work will find it absolutely necessary to treat the lighting, as well as the wiring, as a strictly engineering problem. The days of guesswork are past. The public has learned a lot about lighting within the past two or three years, and is rapidly learning more. The electrical contractor who will become a constructing illuminating engineer has greater opportunities at the present time for the extension of his business than have presented themselves within the past twenty-five years.

## A Correction

In the article describing the "Great White Way of Knoxville" in our May issue, the writer referred to the Central Station of that city as the Knoxville Electric Company, which was doubtless a mere inadvertence. The Central Station of that city is the Knoxville Railway & Light Company. The Knoxville Electric Company is a contracting and supply concern.

# Correspondence

## From Our Readers

In an editorial in our last issue we called attention to the fact that the new high efficiency electric lamps would strengthen the position of the electric lighting interests in their competition with gas. In order to learn how the situation is viewed by the gas interests, we sent out letters of inquiry to a number of representative companies, and give below some of the replies received.—Ed.

From the Milwaukee Gas Light Co.

Gas men must necessarily appreciate the possibility of strong competition from the new types of high efficiency electric lamps, but in my estimation this increased competition can only result in greater activity in the development of more efficient gas burners.

The electrical engineers deserve great credit for the energetic methods employed by them in all phases of the development of their business. Gas engineers should not fail to profit by the example set for them by their electrical brethren, and, if possible, go them one better.

Gas lamps showing an efficiency of over 30 candles per foot have been upon the market for some time. This means, with $1 gas, the equivalent of over 300 candle hours for one cent. Admitting an efficiency for the Tungsten lamp of 1¼ watts per candle, we have, with current at 10 cents per kw., but 80 candle hours for one cent, with a very much higher maintenance cost for the electric lamp.

At the recent exposition held in Edinburgh, numerous gas lamps were shown having efficiencies of over 50 candles per foot, and one lamp showing above 70 candles per foot, or the equivalent of over 700 candle hours for one cent with $1 gas.

Does this not mean that your inquiry should be directed to our electrical friends as well as the gas men? Yours truly,

S. J. Glass,

From the Suburban Gas Co., Chester, Pa.

Replying to your letter of the 18th, would say that while there has been a great improvement in electric lights, there has also been great improvements in gas lights within a similar period, and I have always felt as I have seen these various improvements come out, that with more hustle on the gas man's part, he will continue to show his percentage of increase the same as he has in the past. We have a list in our office of some 840 different uses for gas, as we are finding new uses every day.

A thorough gas man believes his product is much better for every use outside, perhaps, decorative purposes, than electricity. The oil man feels the same, and the candle manufacturer is making more candles to-day than he ever did.

I believe the new high efficiency electric lamps will be an additional problem to the gas man to keep his gait up.

I see many indications that the gas man is waking up, especially in design of fixtures, systems of lighting gas without matches, which are being worked out very successfully. If the gas man should go into the maintenance of individual lights, I think he could recover lots of business in the illuminating line. He can certainly give more candle power to-day for the same money than any other system of lighting, and it is up to him to apply himself to the problems of artistic lighting with gas. He should not dwell too much upon the fact that he has the cheapest, but that he has the best light for all purposes.

The above covers, in general, our policy.

Yours truly,
J. D. Shattuck,
General Manager.

FROM THE DETROIT CITY GAS CO.

We appreciate that the efficiency of the tungsten lamp is a talking point in favor of our competitors, but we do not believe that they can get any great amount of business from this point.

From the standpoint of cost we still can give the same amount of light for one-quarter as much money where gas is figured at $1 per thousand and the electric current at 10 cents per kilowatt; or we can give twice as much light for half as much money. Then, our maintenance cost will be very much less than the cost for the Tungsten lamp. Each time that the tungsten lamp is burnt out it necessitates the expenditure of $1.50, approximately, for a new lamp, where with gas the cost would be from 25 to 35 cents when the mantle and cylinder are broken. We believe that the life of a mantle will be as long as the life of a tungsten lamp.

In the larger stores the tungsten lamp will probably replace the ordinary incandescent bulb, but this will in no way affect our revenue. It gives the electric company an opportunity to give more to the consumer for his money.

In the smaller stores we are arranging a cluster of Reflex burners that give a very decorative appearance, and are operated by two positive chains to turn on and off the entire cluster. With this we can give more of a better diffused light for less money. We are able to get this combination by means of a separate pilot system in the arms of the fixture. We use the same scheme for side lights. All that is necessary is to turn the key for light. We have tried this system now for approximately a year without developing any serious flaws.

We are also making a cluster of the Welsbach Junior Burners, that may be sold reasonably for an installation in the smaller stores and saloons and for the merchants in the outskirts of the city, to compete with the Nernst lamps and the tungsten cluster. With this scheme we can give five burners in a cluster, all operated with two chains, and the cost of installation is approximately one-third the cost of a four-cluster tungsten or a four-glower Nernst, and will give 250 candle-power, at a cost of not to exceed three-fifths of a cent per hour.

With the cost of installation less, with the cost of operation less, and the cost of maintenance less, and at the same time giving more light, I do not see why we should not get the business.

Very respectfully,
DETROIT CITY GAS COMPANY,
ALONZO P. EWING, Mgr.

## A Correction

*Editor* ILLUMINATING ENGINEER:

Dear Sir:

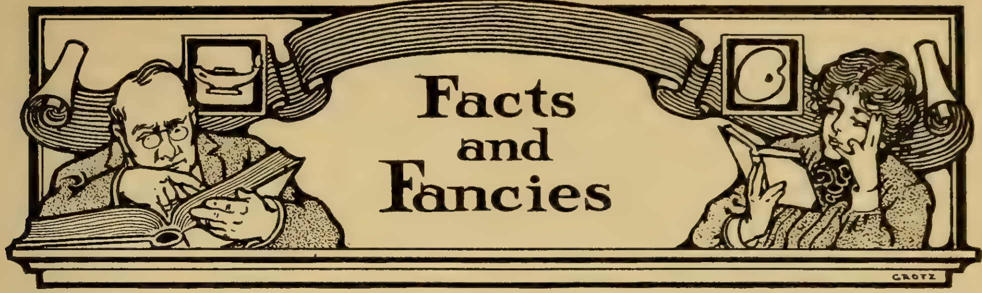
I desire to call attention to the following corrections in my article on Page 214 of the June number of the ILLUMINATING ENGINEER.

In the first paragraph, second column, reference is made to a polar diagram, Fig. 2, and the notice omitted that same was taken from the paper on "Illuminating Engineering," presented by Mr. W. D'A. Ryan at the recent N. E. L. A. Convention in Chicago.

About the center of the same column, "Fig. 3," as given, should read Fig. 1; Fig. 3 being a theoretical point source.

In the second column of Page 216 the equation given, $I_n = \frac{c\ p}{D^2}$, should read, $I_n = \frac{c\ p}{d^2}$; d being the distance in a direct line from the light source to the point observed, D as used refers to distance from the foot of the perpendicular, where H is the hight of the light source above the plane. In the same paragraph, "To obtain this," should be omitted, having no connection with the statements preceding or following.

Yours truly,
NORMAN MACBETH.




# The Pressure of Light

A scientific generalization, or in more popular parlance, a "natural law," has recently been developed, which in its scope and importance is on a par with the law of universal gravitation enunciated by Sir Isaac Newton. The law of gravitation accounts for the behavior of all bodies of matter in the universe; the term "bodies" being understood to refer to such aggregations as we are familiar with through the unaided senses of vision and touch, from the smallest visible particle to the earth itself, the sun, and all the heavenly bodies. In the extent of its application, and the absolute inerrancy with which it accounts for all the motions and positions of the infinite number of bodies which make up the universe, the law of gravitation is undoubtedly the greatest single generalization of science. The enormous progress in the perfection of scientific instruments, and particularly those dealing with the phenomena of light, since Newton's time, has brought to observation a long series of phenomena which Newton's law is wholly inadequate to explain. They were simply unsolved riddles of science. The refinement of scientific instruments, which had been the means of uncovering these mysterious phenomena, has finally afforded a means for the solution of the puzzle. It may be recalled that Newton waited some thirteen years after first conceiving the law of gravitation before he was able to satisfactorily verify it; and the verification was made possible by the correction of certain astronomical measurements. It thus appears that the advancement of science is determined by the accuracy of its means and methods of measurement.

This new discovery of the pressure of light is the subject of an uncommonly clear and attractively illustrated article by Mr. Waldemar Kaempfert in *Harper's Magazine* for June; and in order to give our readers some idea of what the law means we can do no better than to quote from Mr. Kaempfert:

> With the aid of instruments that feel what our hands can never feel, and see what our eyes can never see, the modern physicist has critically analyzed the radiation that beats upon this Earth from the distant Sun. He has cast the solar effulgence into mighty mathematical scales, and has found that the Earth sustains a light-load of 75,000 tons. Startling as this intellectual achievement may be, it has been outdone by the ingenuity of the experimental scientist. Instruments have been devised that enable even our imperfect retinas to note the pressure of light—instruments which offer that convincing objective evidence demanded by the scientifically uninformed man.
>
> Granting that the Sun's light presses upon the Earth with a measurable force, what is the good of the discovery? Simply this: Ever since astronomy was reduced to a more or less exact science the men who watch the stars each night during their active lives have marvelled at some of the miracles that they beheld and have sought to explain them. Why, for example, does a comet's tail, in defiance of the laws of gravitation, invariably drift away from the Sun? What is the meaning of the great scarlet streamers or clouds that swim over the Sun, and of the wonderful gossamer corona that floats far beyond the Sun and is seen only during the few fleeting moments of a total eclipse? What is the zodiacal light, that shimmering fabric which is mysteriously spread on the western horizon during the clear evenings of winter and spring? What is the message of the Aurora Borealis and its leaping pillars,

of which each arctic explorer brings back some new and marvellous tale? Widely different in character though these astronomical riddles may apparently be, the magic key by which they have all been unlocked is the pressure of light. The common solution of all these problems we owe to four brilliant scientists, a Russian, two Americans, and a Swede. It was a Russian—Lebedev—who first experimentally proved that light really does press upon the objects which it illuminates; it was the Americans—Nichols and Hull—who improved upon his method and confirmed his discovery; and it was the broad mind of a Swedish physicist—Svante Arrhenius—that cosmically applied the principles involved in light pressure and brought into a simple harmony all this astronomical discord. New though these theories may be, they have been accepted by even the more conservative students of science.

Before we can hope to understand just why it is that the effect of solar radiation explains the vagaries of all these unrelated phenomena, we must understand how light pressure acts. Because we are not flung from the Earth by a sunbeam, we may well infer that the pressure of light can sway individually only the minutest particles of matter. This is the reason: Gravitation attracts entire masses; pressure acts only on surfaces. Divide a ball of wood or metal weighing one pound into one hundred smaller balls. Clearly, the mass remains unchanged and the one hundred balls still weigh one pound. The surface of the one hundred balls, however, is considerably greater than that of the original one-pound ball. In other words, a force, such as the pressure of light, would obtain a greater purchase on the one hundred little balls than it would on the single large ball. If you subdivide each of the little balls into a hundred parts in turn, the resulting ten thousand balls still weigh one pound, but the surface exposed to the pressure of light is enormously increased. If this process of subdivision be carried on and on, this will happen: particles will be obtained which, individually considered, may be said to consist of much surface and very little weight. If each of these particles has a diameter of 1-100,000 of an inch it will be exactly balanced in space, pulled by gravitation (weight) on the one hand and pushed by light on the other. When the particle is smaller than 1-100,000 of an inch in diameter, gravitation is no longer able to hold it, and it is cast forth by the terrific pressure behind it.

Careful observations extending over centuries, coupled with what we know of the meteorites that sometimes bury themselves in the Earth, have taught us that a comet may be regarded as a nucleus composed of more or less coarse grains of solid matter, of an envelope which is called the "coma" and which surrounds the nucleus, and lastly of a tail trailing luminously behind the nucleus for perhaps a hundred million miles or more. Obviously, the meteoric grains constituting the nucleus are so large that they must surely resist the pressure of light. In the gaseous envelope or coma, and, above all, in the tail, we must look for evidences of light pressure.

No bridal veil was ever so filmy as a comet's tail. Hundreds of cubic miles of that wonderful appendage are outweighed by a jarful of air. By means of the spectroscope we have magically transported this fairy plume to our laboratories, and have discovered that it is akin to the blue flame of our gas stoves; for the gas by which we cook and the delicate tresses of a comet both consist of combinations of hydrogen and carbon, appropriately called by chemists "hydrocarbons." When it first appears in the heavens, far removed from the Sun, a comet is a tailless blotch of light. As a comet swims on toward the Sun, the hydrocarbons of the tail split up under the increasing heat into hydrogen gas and hydrocarbons of a higher boiling point. With a still closer approach to the Sun, these more resistant hydrocarbons eventually yield to the increasing heat and are decomposed in the form of soot. Interplanetary space is airless. Hence the soot cannot burn. It must pursue the comet in the form of a dust train. The particles constituting that train are small enough to be toyed with by the pressure of sunlight. No matter where the comet may be in its orbit, whether it has just entered the solar system or is speeding away, that plume is inevitably tossed away from the Sun, just as if a mighty wind were blowing it from the central luminary. The appendage of shining dust is the symbol of the triumph of light over the solar gravitation.

One more question must be answered before these cometary vagaries may be considered fully explained. Is the pressure of light sufficiently rapid in its effect to account for the flashlike rapidity with which a comet's tail changes? Newton saw the great comet of 1680 throw out a tail sixty million miles long in two days. Is the pressure of light able to accomplish that staggering feat? Arrhenius has calculated that a particle of one-half the critical diameter would be hurled through space by light pressure at the stupendous speed of 865,000 miles an hour. Cometary dust particles are only one-eighteenth of that diameter, which means that they would flash over the same 865,000 miles in less than four minutes. Clearly, light pressure is more than equal to the task of tossing out a luminous pennant

sixty million miles in length in two days.

In order that we may link the tails of comets and the phenomena of the Sun in the kinship of cosmic forces we must commence again by stating in a simple way the nature of the solar secrets which are to be revealed. The great ball of fire which we call the Sun is not really the Sun. No one has ever seen the Sun. A series of concentric shells envelops a nucleus of which we know absolutely nothing except that it must be almost infinitely hotter than the fiercest furnace, and that it must amount to more than nine-tenths of the solar mass. That nucleus is the real Sun, forever hidden from us. The outermost of the enveloping shells is about five thousand miles thick, and is called the "chromosphere." It is a gaseous flood, tinted with the scarlet glare of hydrogen, and so furiously active that it spurts up great tongues of glowing gas ("prominences") to a height of thousands of miles. Time was when this agitated sea of crimson fire could be seen to advantage only during an eclipse; now special instruments are used which enable astronomers to study it in the full glare of the Sun. Beyond the chromosphere, far beyond the prominences even, lies the nebulous pallid "corona," visible only during the vanishing moments of a total eclipse, aggregating not more than seven days in a century. No one has ever satisfactorily explained how the highly attenuated matter composing both the prominences and the corona is supported without falling back into the Sun under the pull of solar gravitation. Now that Arrhenius has cosmically applied the effects of light pressure a solution is presented.

The Sun admittedly projects vapors into space, vapors which must condense into drops when they encounter the cold of outer space. If the drops are larger than the critical size which determines whether light pressure or gravitation shall prevail, they will be snatched back by the Sun's gravitational attraction and give rise to the curved prominences that are often observed. If they have approximately the critical diameter, they will float above the Sun in the form of beautiful carmine clouds, balanced in space by the equal and oppositely acting forces of gravitation and radiation pressure. These clouds have hitherto been particularly puzzling; for in the absence of a dense solar atmosphere their existence seemed a celestial paradox. If the condensed drops are smaller than the critical diameter, they will be projected by the pressure of light far beyond the Sun to form the beautiful pearly corona. Just as in a comet's tail there are in all likelihood particles of various sizes, so in the lustrous corona we may assume that there are drops of unequal size supported with unequal force by the pressure of light. Drops of the same size will be collected in one plane; drops of another size in another plane. Thus Arrhenius accounts for the characteristic flaxen and fibrous appearance of the corona. From the fact that comets have passed through the corona without any very apparent retardation we may gain some idea of its tenuity. Assuming that the corona consists of particles of such size that the radiation pressure on each exactly equals its weight, Arrhenius finds that the entire corona weighs no more than 12,000,000 long tons, which is equivalent to four hundred large transatlantic steamers, and is not more than the amount of coal burnt on the Earth every week.

## Don't Blow Out the Arc Lamp

A new negro messenger in the library of the Navy Department was told by a sophisticated messenger of his own race that a new arc light recently installed there could be blown out.

"Sho," he said, "yo' cain't blow out electric lights."

"Not that kind," said the other, pointing to the incandescents; "but you can these. Try it."

Neither the first puff nor the second was successful, but on the third, into which an extra effort had been put, the light went out.

"There," said the sophisticated one, who was leaning carelessly against the switch button.

The new darky started out to spread the news. He struck incredulity in a messenger just around the corner of the corridor.

"I know yo' cain't blow out dem in bottles," said the new messenger, "but yo' cain dese. Bet yo' a dollah I does it in free blows."

That is where he paid a dollar tuition.

## A Luminous Clock

The Eiffel Tower in Paris is now being used for another practical purpose. On the sides of the second section, hundreds of feet above the ground, a luminous clock warns the gay Parisian of the passing span of life. The apparatus flashes forth every minute in huge figures visible a great distance. This system was found the only practical one, as the ordinary clock dial would be indistinguishable at such a height.

CASHIER BOOKKEEPER CONTRACTS ADVERTISING

# Commercial Engineering of Illumination

## Asa Todd's Illuminated Sign

By Guido D. Janes.

When Asa Todd was in the retail clothing business in Ducktown year before last he wanted an illuminated sign. He had a cash register, a delivery wagon, and three clerks. So all he lacked was the above-mentioned sign.

Ducktown had neither electric light nor gas, and coal-oil was very high. Consequently he sat up at nights studying out how to cater to his wish. It was no uncommon occurrence to see him burning the midnight oil endeavoring to figure out a scheme whereby the folks of the municipality could read his sign after supper.

One p.m., very late, while engaged in the great perplexing question of illumination, a firefly sauntered into his residence. Asa looked at it a moment. Then he smiled vehemently and went straight to bed. On the following morning he arose bright and early. After dressing he journeyed to the local sign painter on Patton street. Reaching his destination he told the fellow that he wished a big sign containing the remark "Asa Todd Clothing." But instead of having electric light bulbs over and following the outlines of each letter, there must be drinking glasses instead.

"All right," said the local sign painter. "I will do it." So he went to work with enthusiasm, and by night had the job completed. He then, with a step ladder and the sign, strolled up to Asa's store, and placed it over the main entrance.

Meanwhile Asa had been out in the suburbs with a net. But as dusk came he came back to the business center of the locality, just as the local craftsman had nailed the words, "Asa Todd Clothing," over the door. "Nice piece of work," said Asa, good naturedly, and climbing up the ladder to the sign. "You are a first-rate artisan."

"Thanks. But I don't see what you want with those drinking glasses over your name. This ain't no dry town."

"Wait and see." And without further ceremony, Asa removed one of the water receptacles and filled same up with light-

ASA AND THE LOCAL SIGN PAINTER.

ning bugs. After doing this he filled up another until the whole lot of them were quite crowded with the insects.

In less time than it takes to tell it, the news had spread over the municipality that Todd had a sign over his place of retail that could be read after supper with ease. So, before Asa had gotten down from the ladder most of the inhabitants were within a stone's throw of him.

"How on earth did you do it?" asked Frank West, the veterinary M.D. "We have no electric light plant in the vicinity."

"I will put you next to the game," said Asa. And he explained at length how he had done it.

The next day the local sign painter had more than he could do, and the next night the lightning-bug around Ducktown was a hunted beast. By the end of the week the town was full of illuminated signs. And the next month Asa was made mayor of the town by acclamation.

ASA IN THE SUBURBS.


THE DUCKTOWNERS FLOCK TO ASA'S STORE.

## The Illuminating Engineer and the Complaint Department

By A. H. Sikes.

Central station managers are anxious to furnish a quality of service so nearly perfect as to practically eliminate complaints from their customers. Many managers depend wholly upon their operating department to accomplish this end, but perfect service or low rates have little to do with the matter. A competent illuminating engineer—a man not necessarily overloaded with theory, but one who exercises good common sense, can do more to free a central station from chronic kickers than a host of inexperienced men could ever accomplish. It is a noticeable fact that the owner of a poorly designed lighting installation will complain of the amount of his bills regularly once a month, while the fact of the matter is that he simply is dissatisfied with the appearance of his place. Many times, one who understands his business can increase this same man's bill 50 per cent. by giving him harmony, beauty, and advertising value as well as mere light from his electricity. Light is common, we can get it from many sources, but light combined with the artistic requires the exercise of judgment and discrimination.

The central station that takes a personal interest in all installations, to see that they are so installed as to give the most uniform illumination combined with economy, is laying the foundation of a friendship with the public that will stand it in good stead in times of trouble on the lines. I have known districts where the store illumination was uniformly good to be without light for an hour in the evening, and not hear a single complaint the next day. This case well illustrates the value of illuminating engineering in creating a friendly feeling and doing away with the complaints.

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"The only shots that count are the shots that hit."—*Roosevelt.*

"Many a man who takes himself very seriously is regarded as a huge joke by others."

"Many a fool is vain and self-deceptive; many a man of great power is modest to the last degree."

"If a man opens his door, his dog runs out in the street before he knows it."

## The Necessity for Reconstructing Old Installations

Since May there has been what is tantamount to a depopulation of a large number of the older office buildings below Twenty-third Street. The exodus is to new buildings, several of which within the Financial District house from 6000 to 10,000 occupants. For the first time since large office buildings have been a factor of importance in real estate, the supply of offices seems to be much in excess of the demand. The result is that the old style buildings are obliged to attract tenants by putting in many things which, so long as the market was undersupplied with rentable offices, the owners would not consider. This condition is making good business for electrical engineers in the putting in of attractive chandeliers and brackets, higher priced glass shades than have been in use until recently, and in the general overhauling of the electrical wiring; and in a number of cases, the installation of new dynamos and a liberal supply of electric fans.

A multi-millionaire owner of a noted old-fashioned office building, not far from the Stock Exchange, lost almost 200 tenants during the spring. He is going to thoroughly overhaul his electrical equipment and put in fine fixtures with shades that will cost three times as much as the old patterns. Most of the old office buildings were so planned as to depend upon artificial lighting even in midsummer, as to most of the offices. When the electric light became well established these buildings were fitted with the cheapest possible electric lighting equipments, but only for the reason that gas lighting made the offices so hot in summer. Numbers of these buildings which never had anything but "drop lights" are now putting in, or are about to contract for, electric fixtures of as high grade as are used in the highest cost new office buildings. Like conditions are reported in several other cities.

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"He who sleeps beneath the fruit trees must be contented with windfalls. The one who climbs the ladder plucks the choicest fruit."

"Whosoever is in a hurry shows that the thing he is about to do is too big for him. Haste and hurry are very different things."—*Moody.*

## A Romance in Real Life

The Illuminating Engineer is not primarily an all-story magazine, nor especially committed to the romantic school of writers. Nevertheless we can appreciate the real thing when it befalls those with whom we are in sympathetic touch. We have persistently denied the allegation that business and sentiment are incompatible, and now we have a shining example of the correctness of our position. The finest sentiment that can ever stir the human heart and the most aggressive and successful business activity may go hand in hand—even to the steps of the altar: in evidence whereof, we present to our readers Mr. and Mrs. George Williams.

George always had very taking ways. He could take hold of a moribund gas or electric company in a somnambulistic town and galvanize it into such a thrilling activity as to fill the stockholders with joy and the citizens with gaping admiration. Within the space of a year he so illuminated Scranton that when, just by way of example, the lights were suddenly turned off one night, the good people thought doom's day was at hand.

But while it took a year to illuminate Scranton, it took but six months for him to let a far greater light into his own life. A half year ago he met Miss Christine Dahl, of Christiana, Norway, the charming and accomplished daughter of one of the most aristocratic Norwegian families, who was then attending the American School of Dramatic Art in New York. She was to have returned to her native land a week ago—but fate, in the person of George Williams, willed otherwise. They were married on June 20, at the residence of Dr. Odell, a Scranton clergyman. After receiving the congratulations of his numerous friends in that city, Mr. Williams and his young bride left for Buffalo en route for Cleveland to attend a convention of electric light men. Later they returned to this city.

The Illuminating Engineer extends most hearty congratulations to Mr. and Mrs. George Williams, and sincerely wishes that it may be said in their romance, as in those of the story books: "And they lived happily ever after."

## Convention of the Ohio Electric Light Association

A most cordial invitation is extended to you to attend the fourteenth annual convention of the Ohio Electric Light Association, to be held at Hotel Victory, Put-in-Bay Island, on Tuesday, Wednesday and Thursday, August 25, 26 and 27, 1908.

The topics to be presented at this meeting, in the form of papers, will be substantially as follows:

"Should Central Stations Do Wiring?"

"Why Municipal Ownership of Lighting Stations Has Not Been a Success."

"How Can We Best Increase Our Business?"

"Experience with Luminous Arc Lamps."

"Electric Signs and Other Special Uses of Electricity as an Adjunct to Profitable Station Work."

"Gas and Gasoline Competition and Best Ways to Meet It."

"Lecture on Illuminating Engineering."

"Best Ways and Means of Keeping Out and Getting Out Private Plants in Central Station Territory."

"The Gas Engine in Central Station Work."

"Gas Producing Plants and Oil Engines and Their Results."

"Report upon the Experience of a Large Number of Central Station Men on the Tungsten Lamp."

In addition to the papers there will be a very elaborate programme of entertainment for all attending, including a banquet for the guests of the association. Due notice of the entertainment, together with the other special features, will be mailed you from time to time. Particular attention is being paid to the provision for entertainment for the ladies, and it is expected that central station men will be accompanied by their ladies in a very great number. The officers of the association especially request that you make your arrangements to attend this convention during the whole of its sessions.

No more beautiful spot can be found to hold a convention than at the Hotel Victory, Put-in-Bay Island. Location is historic and the arrangements for the entertainment elaborate. A very low rate has been granted by the Hotel Victory, which is now under new management. No charge will be made by the hotel for exhibitors' space.

F. M. Tait, President.
D. L. Gaskill, Secretary.

## Illuminating Engineering as a Commercial Factor

By V. R. Lansingh.

*A Paper Read at the N. E. L. A. Convention.*

(*Continued.*)

Mr. H. J. Gille, contract agent for the Minneapolis General Electric Company, writes: "We are firm believers in the value to us of urging better illuminating methods, and of giving the customer the greatest service at the least cost for current. We believe that solicitors should be all-around men in their particular field, and that this move will tend to attract better men for the work and make these men worth more money. The new lamps, glassware, improved methods and general publicity (with a view to popularizing electricity and acquainting the public with its advantages and economy), will ultimately result in greater gain to the lighting companies."

We thus see that there is a unanimity of opinion on this subject from practically all those who have gone into it carefully. These opinions may be summed up:

*First:* It is up to the central station to carry its responsibility further than simply furnishing so much electricity, and that it must, for its own protection, if nothing more, see that the customer gets the best possible results at the least expenditure of energy.

*Second:* In order to do this the company must see that the customer's lighting installation is properly designed.

*Third:* The company must see that the customer is furnished with the latest lamps and shades in order to get the best results.

*Fourth:* It is to the company's interest to see that the customer's bills are reduced to the lowest amount possible per hour of burning, which experience proves will result in longer hours and a greater increase in current consumption.

*Fifth:* It is a central station's business to see that the customer's installation is kept in proper order and up to date in accordance with modern ideas of illumination. If this does not come voluntarily from the central station itself, it will necessarily come sooner or later from the customer, as such ideas spread rapidly, and the central station will suffer instead of getting credit of trying to please its customers.

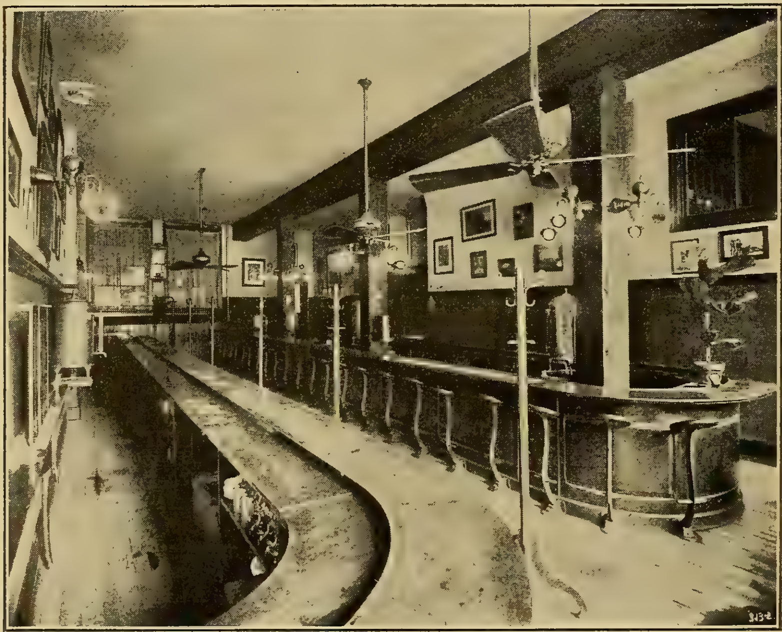


FIG. I.

### What Is Necessary for a Solicitor to Know.

As has been said, it is not necessary in most cases that a solicitor be a trained illuminating engineer or that his knowledge of the subject go much farther than a good general understanding of the principles of illumination, backed by a keen sense and ability to select what is good and eliminate what is bad in any installation.

Thus, Mr. R. E. Brown writes: "I have seen scores of cases where a solicitor who

had no knowledge of light distribution other than that obtained from the data supplied by the various lamp manufacturing companies and the cards sent out by the Holophane Company showing curves of distribution by means of holophane glassware has successfully corrected defective installation at small expense to the customer, giving increased illumination at no greater expenditure for current."

Mr. Laurence Jones writes: "In our opinion the lighting solicitor should not only be equipped to point out convincingly in a general way the advantages of electric lighting, but he should also be in a position to furnish plans for the lighting equipment calculated to produce good results. We have taken pains to see that our solicitors are instructed carefully along these lines, and they seem to handle in a satisfactory way most propositions that confront them."

Mr. Golding states: "A knowledge of illuminating engineering imbues our solicitors with more self-confidence, making it easier for them to secure desirable business and pleased consumers."

Mr. R. E. Brown, again: "A little knowledge may be a 'dangerous thing,' but a little knowledge of the elementary principles of illuminating engineering is better than none at all. My opinion is that a fair working knowledge of illuminating engineering work is not only desirable, but is to-day an essential qualification for a successful solicitor for a lighting company. This is the day when the man who knows is the man who gets the business. The merchant depends in a large degree on the representative of the lighting company to give him satisfactory service at the right price, and when the solicitor approaches a merchant with a lighting proposition he does so knowing that the success of his effort depends largely on the application of his own knowledge and that the business of his company will grow in exact proportion to the satisfactory service given as the result of his applied knowledge. Hence it is to the advantage of every company selling illumination to see that its solicitors are equipped with a good working knowledge of the art of light distribution."

This does not mean that the mathematical and technical sides of the subject are to be entered into in detail, but it does mean that every salesman should have a knowledge of the proper kinds of lamps to be used under different conditions, correct heights and distances at which they should be placed, the equipment of the lamps, what lighting will result and the cost of operation of the system adopted.

FIG. 2.

With this knowledge any solicitor can offer a lighting scheme that will be attractive in competition and convincing to the prospective customer, which are the essential factors in securing new business.

### Future Outlook.

If the methods given here are carried out there seems to be little, if any, doubt that despite the introduction of new illuminants that result in decreased cost per candle-power to the customer and the introduction of new methods of using these illuminants, which result in lower cost per unit of illumination delivered, the income of the central station will materially increase. This increase will be due, first, to longer burning hours; second,

to use of a higher standard of illumination; third, to large extension of business by people who are at present not customers, and, fourth, indirectly to the forestalling of competition.

Mr. Joseph D. Israel, district manager of the Philadelphia Electric Company, says: "The future outlook is most encouraging, as our figures show that by following the above methods we are securing more new business and giving greater satisfaction to old customers."

Mr. F. M. Tait says: "The future outlook for the lighting companies carrying on methods of better illumination for the customers who are not making full and complete use of their electric lighting service cannot be otherwise than very encouraging. We feel enthusiastic over the prospects, and our installations to date prove that our faith is well grounded."

## Practical Applications.

The above quotations seem to thoroughly establish the truth that it is a desirable thing for the central station to further the cause of good illumination. In order to see how this has been carried out to some extent in the past, a number of practical examples from different companies that have tried these methods are here given in condensed form. The examples include cases where gas competition has been overcome, where dissatisfied customers have been won back, and where cutoffs have been avoided.

Fig. 1 shows a restaurant after being duly changed. The old installation consisted of fifteen fixtures of three lamps each, pointing upward, with heavy sand blasted globes throwing the light toward the ceiling, there being a total consumption of 1350 watts. In the new installation the fixtures were reversed so as to point directly downward. This resulted in a saving of 45 per cent., while the illumination was increased 40 per cent. in useful directions.


FIG. 3.

Examples from the Boston Edison Company: This city furnished many interesting cases of replacement of gas by electricity. Thus, a provision store in Somerville, formerly lighted by large gas mantle burners, has installed tungsten lamps, replacing the gas entirely. This customer was using electricity in his windows only. The light has been increased both in quantity and quality, and the income has also been increased. Another example is that of a large department store that had used electricity for years, but the proprietor became dissatisfied with the amount and quality of the light, and concluded to put in gas. He actually made a contract with a gas piper to fit up his store at an expense of $300. The trial of a few tungsten lamps, however, changed his mind, and an agreement was secured with him whereby he canceled his contract for gas pip-

ing and agreed to use tungsten lamps. Seventy 100-watt tungsten lamps weer to replace thirty 125-watt Gem, thirty 100-watt Gem and nine 250-watt Gem lamps—7000 watts in place of 9100. The result is decreased income, but a great deal better lighted store and a customer saved.

Another striking example is that where formerly there was an installation of four 3-ampere, direct current arcs, consuming about 500 kilowatt-hours per month; insufficient light and what they call excess charge, prompted them to replace electric with gas arcs. These in turn proved inadequate, and electricity, about 90 kilowatt-hours monthly, was used in conjunction with the gas. This, too, was unsatisfactory, and after much persuasion they consented to throw out the gas and install twelve 100-watt tungsten lamps; the consumption of current being practically the same as in the first installation, but the lighting far superior. Result: a perfectly lighted store and a well satisfied customer.

Fig. 2 shows a picture of the Drysdale store at Bennington, Vt. This installation, under the direction of Mr. E. E. Larrabee, general manager of the Bennington Electric Company, was entirely overhauled and the latest types of lamps and reflectors installed. The amount of illumination has been increased some 20 per cent., while the cost of maintenance has been decreased at least 25 per cent. Mr. Larrabee stated: "We made the change in one room at our own expense, as a matter of advertising and as the most convincing argument we could put forth in favor of the economy of using higher efficiency lamps with proper reflectors. We think the Drysdale store is one of the best illuminated places in the State of Vermont and that Mr. Drysdale is as aggressively up to date as any merchant in New England. We delight in doing anything we can for him on this account and because he appreciates that whatever efforts we make to increase his illumination is of vital importance to his success."

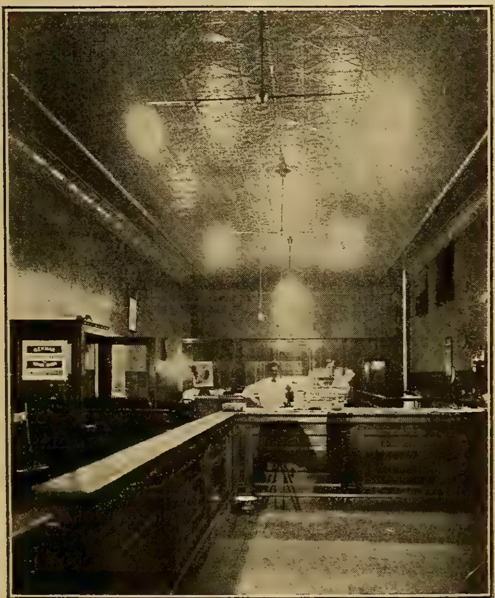


FIG. 4.

Fig. 3 shows a drygoods store at Rockford, Ill. This store was originally equipped with nine direct-current arc lamps which did not illuminate in a manner satisfactory to the customer. The arc lamps were replaced by nine Harter clusters, each containing six 100-watt frosted Gem lamps. The store is far better lighted, the absence of shadows is striking and the consumer is entirely pleased.

El Paso, Tex., furnishes a number of interesting examples of what can be done by modern methods. Thus, there is one drug store which Mr. C. W. Kellogg, Jr., manager of the El Paso Electric Railway Company, states is probably as brilliantly illuminated a little store as there is in the country. It is 33 feet by 15 feet and is lighted with eight single-glower Nernst lamps arranged in art fixtures, and twelve 16-cp. lamps arranged in electroliers, giving a total of 592, or 2.87 watts per square foot.

The First National Bank of El Paso is lighted throughout with twenty 4-glower Nernst lamps, fitted with canopy housings against the ceilings. There is a total candle-power of about 9000, giving 2.4 watts per square foot of floor space.

Mr. Gille, of Minneapolis, gives a very striking example of what can be done along these lines. In one cigar store he recently took out two 3.25-ampere arcs and eighteen 35-reflector lamps in the window, and replaced the arcs with eight 40-watt tungstens and the reflector lamps by seven 40-watt tungsten lamps. "From an average of $23 per month, his bills were reduced to $13," says Mr. Gille, "and he is now a booster for us."

In a saloon where there were five 3.25-ampere arcs and two 187-watt units, the customer ordered out the arcs and put in five gas arcs and two single burners. In one month we replaced them with fourteen 40-watt tungstens, giving him a uniform illumination with a reduction of about 25 per cent. in his bills. He says nothing more about putting in gas.

Figs. 4 and 5 are two striking examples from Dayton, Ohio, showing photographs taken at night. Fig. 4 is a telegraph office that formerly used three 4-mantle Humphrey artificial gas arc lamps with slightly opalescent globes and white enameled metallic reflectors.

The gas arc lamps were spaced in the room to produce the best lighting results possible, and in addition there was one ordinary cord pendant and two side brackets, each carrying an ordinary carbon 16-cp. lamp for use near the switchboard and operator's table. The average gas bill for this installation was $13 per month, with an additional average electric light bill of $6 per month, or a total average monthly bill of $19, for both kinds of light. It was decided to equip this telegraph company's office with the installation shown in the photograph and learn what results could be obtained in competition with the 85-cent artificial coal gas formerly in use, the electric current rate for the installation being nine cents per kilowatt-hour net. Six 100-watt, frosted tip, 110-volt tungsten lamps were used in connection with the holophane frosted, crimped edge bowl reflectors. The telegraph company would not allow a change of wiring, on account of a metallic ceiling. The fixtures have a spread of 72 inches across lamp centres and 24 inches from ceiling to bottom of lamps. The tips of the lamps are 13 feet from the floor. The room is 23 feet 3 inches wide and 62 feet long and ceiling 15 feet high. The fixtures are arranged with push button switches that permit one lamp on each two-lamp fixture to be shut off if not needed. The former cord pendent and two side lights were abandoned entirely. The telegraph company is highly pleased with the illumination produced; also with the lighting bills for the new service, which average $14 per month. The company is also plased with the results, having secured complete electric service from this customer in place of merely having but 32 per cent. of the lighting heretofore, and of course doing all of this without being obliged to increase the service main meter, and so forth.

Fig. 5 shows a prominent drug store in Dayton, and is an example of a store with a very low ceiling. This store was formerly lighted by means of a 12-hp. natural gas engine electric lighting plant using 30-cent natural gas.

The former illumination was obtained with the use of the ordinary 8-cp. clear glass carbon lamps spaced 56 inches in a rectangular shape on the ceiling. Each lamp was used with a 10-inch white porcelain flat reflector and the lamps were spaced 4 feet 3 inches from the walls. Three artificial gas arc lamps and two 2-burner gas fixtures with 6-inch mantle lamps on same were also used to help out in case of failure of the gas engine plant and for special illumination on Saturday nights. Seven 100-watt, 110-volt frosted tip tungsten lamps with clear glass holophane reflectors were installed at proper locations, using lamp cord extensions from the most convenient ceiling receptacles formerly used in the old scheme of lighting. This installation was put in in a temporary manner for a 30-day trial and has since been formally accepted and a term contract made for the new service. The gas engine plant has

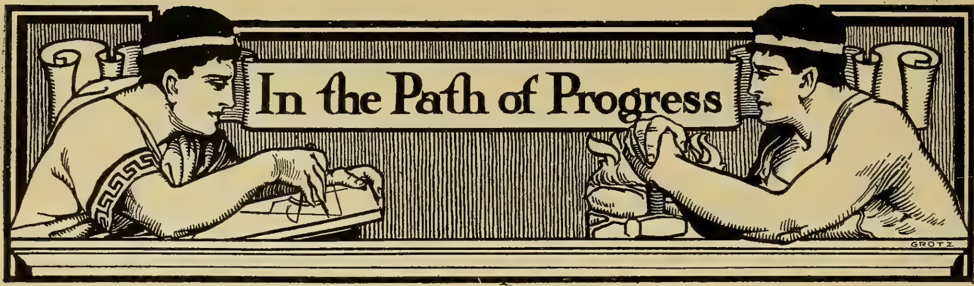
FIG. 5.

been sold for junk, and the gas lamps have all been removed. The store measures 79 feet long by 14 feet 9 inches wide by ceiling 9 feet 6 inches. The ceiling of the drug store is papered with light paper and the side walls are covered entirely with white enameled cases, carrying bottles and goods usually found in these stores. The tungsten lamps are supported as close to the ceiling as it was possible to place them. A number of similar installations have been successfully made in other stores, covering a wide range of merchandise sold under the tungsten light, and Mr. Tait says that he proposes to clean up his down town business section of the city with further installations of this character. A striking example of "before and after using" is shown in Figs. 6 and 7, which are here reproduced through courtesy of the ILLUMINATING ENGINEER. These photographs were taken in an office building at Forty-first street and Park avenue, New York. The lighting, as originally planned, contemplated the use of four incandescent lamps in clusters under flat porcelain shades. When the matter was finally placed in the hands of Mr. Henry Goldmark, the consulting engineer, the outlets and wiring were installed. It was finally decided to substitute for each cluster a single 100-watt tungsten lamp on a 4-inch stem fixture with pull socket and holophane sand blasted bowl reflector. On a basis of three cents per kilowatt-hour for current, each 100-watt unit shows a saving during its life of $1.35 over the cluster that it displaced, or an estimated annual saving on the whole building of about $450. In order to arrive at a perfectly fair and even comparison of the two systems, two offices of exactly the same dimensions were fitted up; one with the 100-watt units and the other with four 16-cp., 50-watt carbon lamp clusters. Careful measurements were taken which showed a saving of 50 per cent. in watts and an increase in illumination of 60 per cent. The photographs show clearly the difference in illumination. Both pictures were taken at the same time, on plates from the same box, with lens set at same stop. They were given equal exposure, the same developer was used on both at once, and they were printed together in the same printing frame. The actual effect was much greater, as the first illumination with the tungsten units appeared much brighter than the actual readings would indicate. This is a very striking example of what can be accomplished, and complete details of the tests can be obtained by referring to the ILLUMINATING ENGINEER, pages 18, 19 and 20, for March, 1908.

FIG. 6.

FIG. 7.

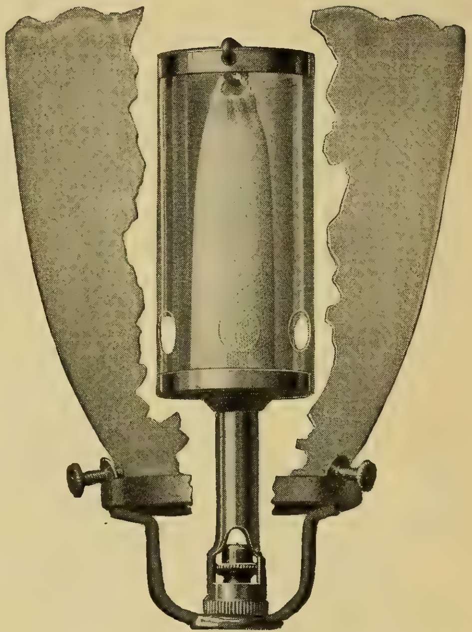
The opinions and examples here cited are taken from the experience of practical central-station men. They prove conclusively that illuminating engineering is decidedly a commercial factor. As to how and where the solicitor or contract agent can find data and information to guide him in undertaking the simple problems that arise in his daily work, reference may be made to two practical works on the subject: "The Art of Illumination," by Dr. Louis Bell, and "Practical Illumination," by Cravath and Lansingh. In addition, the current developments in the art are published in the technical press, of which the ILLUMINATING ENGINEER is devoted solely to this subject. Finally, much interesting and valuable data are constantly being offered in the publications of the engineering departments of the National Electric Lamp Association, General Electric Company and the Holophane Company.




## A New Incandescent Gas Burner

The electric lighting interests are not going to have things all their own way, even if their new lamps do run on one-third the current of their old ones. The Welsbach Burner, which saved the day for gas when the carbon filament electric lamp threatened its total extinction, has not been indulging in any Rip Van Winkle sleep. To the question, "What are you going to do about it?" the Welsbach Company makes answer by presenting to the public its new "Junior" Burner.

Undoubtedly the feature of the electric light which had most to do with its rapid introduction and enormously extended use is its extreme simplicity. It is one of the very few devices that has been put into the hands of the public in a form that is practically fool-proof. In this respect the mantle gas burner has had to admit its inferiority, and fall back upon its greater efficiency as a compensating advantage. Since progress in electric lamp manufacture has recently greatly reduced this advantage of gas, it is interesting to note that the Welsbach Company has attacked the electrical competition in its stronghold of simplicity. The Junior Burner, illustrated herewith, is a complete lighting unit, consisting of burner, chimney and mantle, and is practically as easy to put on and remove as an electric lamp. The price of the outfit is but 35 cents retail, less than twice the price of the ordinary 16 c.p. lamp; so that the consumer who does not wish to take the trouble to renew the mantle and chimney may simply throw the whole thing away, and replace it with a new one without feeling that he is committing any extravagance. It is not necessary, however, to throw away the burner tube, as the chimney and mantle form an easily removable part.



The burner gives about 50 c.p. rate in the same way as an electric lamp on a consumption of 1¾ to 3 feet of gas per hour. As the life of a mantle is practically the same as that of the ordinary electric lamp, and as this little burner gives four times the light, the cost of renewals if the entire outfit is thrown away is much less than that of electric lamps.

Besides the great convenience of having a self-contained unit, this burner is of such size and dimensions that it can be used with the regular electric shades and glassware. This would seem to be a real case of "filling a long-felt want." The Welsbach Company says, what is readily apparent, that the margin of profit on the burner is small, but that the demand should be sufficiently large to give a satisfactory aggregate. This burner should prove of valuable assistance to the gas companies in meeting the competition of the new electric lamps.

## The Bureau of Illuminating Engineering

The Bureau of Illuminating Engineering was established somewhat more than a year ago, for the purpose of affording to those who desired such services strictly impartial and high-class consulting illuminating engineering. The Bureau is incorporated under New York State law, and has offices at 437 Fifth Avenue, New York. Its personnel has recently been reorganized. Major E. L. Zalinski (U. S. A., Rtd.) assumes the presidency, and Mr. A. J. Marshall becomes the managing engineer. Major Zalinski is too well known to require any further comment; in fact, there are few American citizens who have a wider international acquaintance than the genial Major. Having become an authority on various phases of military science, particularly artillery, he became especially interested in the subject of illuminating engineering some ten years ago, and has devoted a considerable part of his time and his peculiarly fertile inventive talent to the development of illuminating appliances since.

Mr. Marshall has for a number of years past been in charge of the Engineering Department of the Holophane Company, and has made a wide acquaintance as a result of extended lecture tours throughout the country for the purpose of arousing public interest in this new science.

There has been some tendency manifested, since illuminating engineering became generally recognized, to brand it as being a mere subterfuge of the large corporations interested in lighting to promote their commercial interests. Before accepting these criticisms at their face value it would be well for the disinterested reader to consider the facts in the case. Every new division of applied science has had to establish itself by its own unaided efforts; the first generation, so to speak, of any new profession must be self-educated. There are no technical schools at the present time giving a regular course in illuminating engineering, and those who claim membership in the profession to-day, and rightly so, have acquired their claim to the title by reason of the knowledge and experience that they have "picked up" from whatever sources were available. Naturally, the corporations dealing directly with illumination, either in the production of luminants or illuminating apparatus, have afforded the greatest opportunities for acquiring such knowledge, and what is really more important, have afforded the first opportunities for bringing such knowledge to practical use. The inevitable and legitimate result of these conditions is that illuminating engineering and illuminating engineers have thus far largely been both produced and employed by commercial interests. The fact that an illuminating engineer has received his training from, and been connected with, some commercial company cannot therefore in any justice be cited as prejudicial to his ability and independence when he cuts loose from such employment and enters the field of consulting engineering. It is doubtful if any illuminating engineer in the country has had the advantages of dealing with a wider range of problems than has Mr. Marshall in the capacity in which he has served for the past several years.

The advantages of utilizing the opportunities of illuminating engineering to promote the interests of lighting companies, both gas and electric, have been not only recognized, but enthusiastically indorsed by the most authoritative bodies in each class, namely, the National Electric Light Association, the American Gas Institute, and the International Acetylene Association.

We are advised that it will be one of the special aims of the Bureau of Illuminating Engineering to give advice and assistance of this kind to such as may not find it expedient to maintain special illuminating engineering departments of their own. In addition to this, it is the purpose of the Bureau to afford a source of absolutely independent and unprejudiced advice to engineers, architects, and the general user of light. Such an enterprise ought to succeed, and we sincerely trust that it will.

Success, however, will depend largely upon two points: First, absolute freedom and independence in the specification of luminants and lighting devices. Personal pets and hobbies have no claims upon the consulting engineer in the exercise of his professional duties; and second, the skill and judgment with which the principles of illuminating engineering are applied to the problems undertaken. There is every reason to believe that in both of these respects the bureau will fulfill the expectations of its numerous friends and well wishers.

## A New System of Constructing Lighting Fixtures

The two points in regard to American manufacturers which most impress the foreigner are the tendency to reduce everything to a system of standards, and to put up goods in handsome and convenient packages. We noted something more than a year ago an innovation introduced by an enterprising manufacturer, which consisted in putting up a line of simple chandeliers in convenient and attractive packages so that even the householder could take them home and install them. We are now informed of a new scheme for constructing standard parts which may be assembled in a variety of ways, so that from the same comparatively few parts a large number of different fixtures can be formed. We are indebted to the manufacturers for the following description:

Wakefield fixtures are not made in denominations of 2, 3 and 4 lights, as are all ordinary fixtures, neither are they made in fixed styles, but they consist of a line of universal stems and arms that are interchangeable, these stems being adaptable for 1, 2, 3, 4 or 5 light fixtures, and the arms are so arranged as to fit on any stem.

The basic principle upon which our fixtures are built is the patent body invented by our Mr. F. W. Wakefield, and this body is a solid metal casting, with the outlet holes so arranged that the arms can be fitted in various groups, so as to make either a 2, 3 or 4 light fixture at the will of the user.

The combination body is of such construction that a stem fitted with this body can be used for either straight gas, straight electric or combination fixtures, and can be used for either a two light or three light gas, and 1, 2, 3 or 4 light electric, and two gas and one electric combination, two gas and two electric, two gas and three electric, three gas and three electric, three gas and four electric, or three gas and one electric, combination fixtures.

Ordinarily if a dealer buys one style of fixture and chooses to stock it in both straight gas and straight electric as well as combination he must buy the two and three light of each of these three different styles. With Wakefield fixtures any stem can be used for either gas, electric or combination, thus saving the dealer about two-thirds of his usual investment.

The interchangeable feature of the arms also multiplies the assortment which he carries, as it allows him to use any arm on any stem, which is not usually the case. These fixtures also contain many labor saving advantages, as they are the easiest to wire and fit of any fixture on the market, they having no nipples or inner iron body that needs cementing or to obstruct the wiring, and they are constructed with the end in view that in the fitting they will be simplicity itself.

## Adapters for Tungsten Lamps

Thus far the commercial tungsten lamp can be operated successfully only in a vertical position. In order to use it therefore in the so-called "wireless clusters" and chandeliers on which the sockets are placed at an angle, it is necessary to use some device by which the angle of the lamp can be changed. "Necessity is the mother of invention"; the need has brought forth the thing. The Benjamin Electric Mfg. Company, of wireless cluster fame, have brought out a very neat and serviceable little adapter which shows

THE BENJAMIN ADAPTER.

for itself in the accompanying cut. It is fitted on one end with the exceedingly clever plug recently invented by Mr. Benjamin, which can be screwed into the socket without turning the attachment itself. At the other end there is the usual Edison socket, and between the two a joint on the ball-and-socket order, permitting the lamp to be turned in a vertical direction no matter what the angle of the plug.

The Dale Company, who have shown their alertness to improvements by bringing out a series of fixtures especially adapted to new lamps, have constructed a device on the same general lines, which is shown below. Like their fixtures, it is particularly well built, and of good mechanical design.

With these simple and inexpensive adapters it is but a moment's work to convert any cluster or chandelier into an up-to-date tungsten lamp fixture.

THE DALE ADAPTER.

## An Automobile Shade Holder

A new shade holder especially adapted for use with prismatic reflectors is announced by the Dale Company. The holder may well be called automatic, since it contains no screws or sliding contacts. It holds itself fast on the socket by spring clips, and the shade is held securely in a similar manner. It consists of but a single piece and is of very neat appearance, as shown by the cut below.

THE DALE SHADE HOLDER.

## Annual Meeting of Fostoria Lamp Men

The annual summer conference of the salesmen of the Fostoria Incandescent Lamp Co. was held during the week of June 20 at Ballast Island, in Lake Erie, near Put-in-Bay. It was attended by about 25 representatives from all parts of the United States, and an extensive programme was gone through with. The meeting was pronounced a marked success, and was an especially important one on account of the fact that this has been the first meeting held since all of the high economy units have been commercially perfected.

## Meeting of Lamp Testers

A meeting of all the lamp inspectors in the employ of the Electrical Testing Laboratories was held in New York on July 6th, 7th and 8th, inclusive. The following papers were presented and discussed:

"Visual Inspections of Electric Lamps," by C. E. Currier.

"The Best Procedure in Lamp Inspection," by C. H. Stephens.

"The Selection of Life Test Samples," by H. E. Allen.

"The Effect of Varying Test Quantity Upon Rejections," by W. F. Teneyck.

"'Bugs' in Photometry," by E. L. Peck.

"Lamp Inspections at Purchasing Companies' Storehouses," by W. J. Bray.

"The Criterion of Lamp Value," by A. W. Minty.

"The Value of Laboratory Tests," by W. H. Robinson.

"The Functions of a Lamp Inspector," by Geo. H. St. John.

"The Responsibilities of a Lamp Inspector," by L. J. Lewinson.

## Sunbeams in Darkest Africa

THE ILLUMINATING ENGINEERING PUBLISHING COMPANY,
12 West Fortieth Street, New York.

*Gentlemen:*

As an item of interest to your readers in general, and as an indication of the relative value of Tungsten lamps of American and German manufacture, I submit the following, received from one of our correspondents in South Africa:

I have just heard from one of my customers for whom you furnished the only lot of Tungsten lamps for me, that these lamps which you have sent are the best lamps in the market, and that in spite of the higher price, he is ordering some more. This I am extremely glad to hear, and I hope that as a result of the trial he has given them, a good market for the lamps cut here may result.

The lot which you furnished me came out with very slight breakage. In fact, there were only six lamps out of the 150 which were broken in transit or in any way defective.

Yours very truly,

SUNBEAM INCANDESCENT LAMP COMPANY,
A. S. TERRY, Treasurer.


# American Items

## New Books

STANDARD HAND BOOK FOR ELECTRICAL ENGINEERING; *by a Staff of Specialists:* Second edition, corrected; McGraw Publishing Company, New York, $4.00 net.

The second edition of this valuable work corrects several errors that were discovered in the first edition. The book is divided into twenty sections, covering every phase of the electrical industries. Each section is edited by some well-known authority on the particular topics treated. The interest in this volume to illuminating engineers centers in section 12, on Illumination, which is treated under the following heads: Nomenclature; Illumination from Luminous Sources; Distribution of Illumination; Requirements in Illumination; Shades and Reflectors; Incandescent Lamps; Arc Lamps; Vapor Tubes; Testing. The section is edited by Dr. Louis Bell, which is a sufficient guarantee of both the accuracy and clearness of the matter contained. The elements of the mathematical basis of illuminating engineering are briefly given, together with a general summary of the data useful to illuminating engineers, that has thus far been accumulated. The book is essentially a work of reference, and has been brought strictly up-to-date. To those who wish a condensed source of information on all topics pertaining to electrical practice the book is well-nigh indispensable.

AGENDA DE L'ELECTRO; illustrated with thirty-eight diagrams; price 5 francs.

This is in small pocket-book form, and contains a large amount of condensed information covering the general field of electrical engineering, especially adapted to conditions as they existed in Belgium. It is edited and published by *Electro,* the electrical journal of Brussels, Belgium.

EVOLUTION OF THE LAMP AND ITS RELATION TO HOUSE FURNISHING, by Jos. R. Bolton, *Pottery and Glass,* July.

A short article tracing briefly the development of the lamp from its earliest known form to the present, with illustrations of modern types. The following account is given of the invention of the lamp chimney, for the truth of which no authority is stated:

Toward the close of the eighteenth century scientists began to give their attention to the oil and its possibilities, and several important improvements resulted. The flat, woven wick, held in a close-fitting support, was the most notable of these, and this was later followed by an attachment—which would be considered clumsy enough now, but which was hailed with great favor at that time—to do away with the smoking of the wick. The lamp chimney did not come into evidence until some years later, and was the result of an accident. One of the artisans in the shop of a Swiss chemist undertook, for purposes of his own, to heat a bottle over the flame of a lamp. The effort was such a success that the bottom cracked and fell out, leaving the man with the top of a bottle in his hand, which was becoming hotter every second. He placed the broken bottle down as quickly as he could, without waiting to see where it would rest, and it happened to come directly over the flame of the lamp, in an upright position. The change in the flame was at once noticed. There was no smoke,

no flickering, and the light was intensified many times. It was not long before this idea was brought to a successful conclusion, and lamp chimneys became immediately and universally popular.

HELPS IN RAPID PRELIMINARY CALCULATION OF ILLUMINATION, by J. R. Cravath and V. R. Lansingh; *Electrical World*, July 11.

The authors have examined all the available data in which actual measurements of foot-candle intensity of illumination resulting from lamps and apparatus in actual operation, and derived a set of empirical values showing the number of watts per square foot of floor area required to produce an average of one foot-candle of illumination, using the various commercial lamps and reflectors now in common use under varying conditions as to the color of walls, ceilings, height of lamps, etc. Following are the values obtained:

INCANDESCENT LAMPS.

Tungsten lamps rated at 1.25 watts per horizontal candle-power; clear prismatic reflectors, either bowl or concentrating; large room; light ceilings; dark walls; lamps pendant; height 8 to 15 feet.................. 0.25
Same with very light walls............ 0.20
Tungsten lamps rated at 1.25 watts per horizontal candle-power; prismatic bowl reflectors enameled; large room; light ceilings; dark walls; lamps pendant; height 8 to 15 feet......... 0.29
Same with very light walls............ 0.23
Gem lamps rated at 2.5 watts per horizontal candle-power; clear prismatic reflectors either concentrating or bowl; large room; light ceiling; dark walls; lamps pendant; height 8 to 15 feet .................................. 0.55
Same with very light walls............ 0.45
Carbon filament lamps rated at 3.1 watts per horizontal candle-power; clear prismatic reflectors either bowl or concentrating; light ceiling; dark walls; large room; lamps pendant; height 8 to 15 feet.................. 0.65
Same with very light walls............ 0.55
Bare carbon filament lamps rated at 3.1 watts per horizontal candle-power; no reflectors; large room; very light ceiling and walls; height 10 to 14 feet ........................0.75 to 1.5
Same; small room; medium walls, 1.25 to 2.0
Carbon filament lamps rated at 3.1 watts per horizontal candle-power; opal dome or opal cone reflectors; light ceilings; dark walls; large room; lamps pendant; height 8 to 15 feet... 0.70
Same with light walls................. 0.60

NERNST LAMPS.

110-watt, single glower, Nernst lamp, opaline ball globe; no reflectors; large room; light ceiling; medium walls... 0.50

ARC LAMPS.

5-ampere, enclosed, direct-current arc on 110-volt circuit; clear inner, opal outer globe; no reflector; large room; height 9 to 14 feet............ 0.50

LIGHT AND POWER IN A MODEL OFFICE BUILDING, by H. Thurston Owens; *Electrical World*, July 11.

An illustrated article describing the light installation of the German-American Insurance Building, New York City.

DENVER'S FAMOUS STREET LIGHTING, by R. Garland Gentry; *Public Service*, July.

Shows a number of night views of Denver's streets, with brief descriptions of same.

THE PAST AND PRESENT OF INCANDESCENT LIGHTING, by Edward R. Knowles; *Electrocraft*, July.

A conclusion of the article begun in the June number. It gives brief descriptions, with their relative advantages and disadvantages, of the different kinds of incandescent lamps.

ILLUMINATION OF THE SINGER BUILDING TOWER, *Electrical World*, July 11.

Illustrates and describes the spectacular lighting of this famous structure.

NUMBER OF LAMPS FOR UNIFORM ILLUMINATION, by Alfred A. Wohlauer; *Electrical World*, June 27.

A mathematical discussion of the problem of placing light-units having a given curve of light distribution so as to produce uniform illumination over a given area.

WHAT IS LIGHT? by P. G. Nutting; *Electrical World*, June 27.

The question is answered by a discussion of the topic from the basis of mathematical physics.

# Foreign Items

Compiled By J. S. Dow.

### Photometry and Illumination.

Moderne Schaufensterbeleuchtung, by K. Stockhausen (*J.f.G.*, June 1, 1908).

This article deals with show-window lighting. The author describes the recent exhibition devoted to this object, at the *Augur* display in Berlin, where a series of windows were erected and a number of different firms invited to compete in illuminating them by means of any variety of illuminant. The author criticises the various methods adopted and divided the exhibits into good, bad and indifferent, according as they comply to a greater or less extent with the essential features of good shop-window-lighting mentioned in the article. This article is practically identical with that contributed in English to the London *Illuminating Engineer* for April.

Ein neues Photometer, by Dr. Lautsch (*Elek. Anz.*, June 11).

The author describes a form of the Rumford shadow photometer. Instead of moving one or both of the sources of light, as in the case of the ordinary type, he arranges to move the rod, by means of which the shadows are cast, along a graduated scale. The method, however, seems to be only intended for sources of light which do not differ in candlepower by more than 25 per cent.

Vergleich der verschiedenen technischen Methoden zur Bestimmung der mittleren horizontal-lichtstarke von Metalfadenkampen, by C. Paulus (*Zeit. f. Bel.*, June 20).

In this article the author reviews the merits of the three chief methods of obtaining the mean horizontal candlepower of metallic filament lamps, namely, by (*a*) individual point to point methods, (*b*), by angle-mirror methods, and (*c*), by rotation methods in which either the lamp is rotated about its vertical axis or the lamp is kept stationary and a mirror is rotated round it.

In the present article he shows a number of polar curves obtained by all these methods by turning the lamp round about its axis while in position, and comes to the conclusion that, when dealing with metallic filament lamps, the mirror method is not superior to the point by point one.

### Electric Lighting.

Electricity or Gas? The Problem of the Small Consumer, by J. D. Mackenzie (*Elec. Rev.*, London, June 12 and 19).

Mr. Mackenzie commences his article by pointing out that although it has been recently assumed, in discussions of tariffs, that it hardly paid to trouble about the small consumer as a means of revenue to supply companies, yet a large number of such consumers within a small area might be worth securing. He admits, however, the difficulty of the initial cost of installation. He gives some curves illustrating the performances of gas-mantles and osram lamps and comes to the conclusion that the latter became the more economical of the two illuminants when electricity can be got for less than 3¼ a unit.

Applications d'Electricite dans les Eglises (*l'Electricien*, June 20).

This article deals with the application of electric lighting to churches. The author states that the common prejudice against modern methods of lighting in a church is giving way to the desire for good illumination. In this respect metallic filament lamps are at an advantage because their drawback of not being obtainable for high pressures and low candlepower is not here so serious. A series of illustrations of electric lighting in various continental churches are shown, but it is possible that many would find the methods depicted unsatisfactory from the aesthetic standpoint.

Fortschritte in der Glühlampen-Industrie (*Zeit. f. Bel.*, May 30 and June 10).

A continuation of a series of articles devoted mainly to recent patents referring to the technicalities of metallic filament glow lamp manufacture. The present instalment treats the question of supporting and winding filaments so as to avoid danger of breakage.

Die Wanderung des Elektrischen Lichts von der Kohle zum Metall (*Zeit. f. Bel.*, May 30 and June 10).

An essay, published as a serial article, contrasting the development of electric illuminants utilizing incandescent solid materials, especially carbon, and those using incandescent vapors and metals. The present instalment of the article discusses the prospects of the mercury vapor lamp.

A Report on the City Lighting, by A. A. Voysey, engineer to the City Corporation (London).

A very complete report on the lighting of several London streets. Illumination-curves and tables of costs are shown and the author comes to the ultimate conclusion that, light for light, flame arcs cost about one-fourth as much as incandescent mantles to maintain. This report has been reproduced in several of London's gas and electrical journals and the July number of *The Illuminating Engineer* (London). Its publication has given rise to considerable comment.

### Gas and Acetylene Lighting.

Compressed Gas and Compressed Air (*G. W.*, May 30).

This is an abstract of the recent contribution of Lux on the subject in the *Zeitschrift für Beleuchtungswesen.* In order to secure the most favorable conditions to combustion in the incandescent mantle it is essential that the air and gas should be mixed in the correct proportions, and should come into intimate contact with each other. This may be done by means of a jet of high-pressure gas which sucks in air with it, or by a stream of high-pressure air, and in the present case the merits of the two systems are discussed, rather to the advantage of the second method.

An article in the *Journal für Gasbeleuchtung* (June 13) discusses the same point.

Blau Gas—A New Gas for Illuminating, Heating or Cooking (*G. W.*, June 20).

This new variety of gas is obtained by distilling at an exceptionally low temperature when the heavier hydrocarbons come over and can be easily condensed into liquid. The liquid is kept under pressure in transportable cylinders, each of which can keep a 50 cp. light supplied for 480 hours. It is claimed that the calorific power of the gas is exceptionally high, and that the very high efficiency of nearly 100 cp. per cubic foot of gas is obtainable.

A series of papers dealing with acetylene lighting were contributed to the International Acetylene Congress in London during the past month. Among these may be mentioned:

Acetylene or Petrol-Air Gas, by C. Bingham.

The author sets out to prove that acetylene is both cheaper, healthier, safer and more convenient than its rival illuminant, petrol-air gas. Considerable interest attaches to the paper because the consumer is practically limited to a choice of these two illuminants in remote districts where gas or electricity are not available. The paper, however, deals with the subject entirely from the standpoint of acetylene.

The Manufacture of Mantles for Incandescent Lighting by Acetylene, by L. Cadenel.

Mantles intended for incandescent lighting by acetylene have to be specially constructed, owing to the great heat of combustion of the air-acetylene flame, which would destroy an ordinary mantle in a very short time. Such mantles are also much smaller than those of the ordinary variety and this again presents special difficulties. M. Cadenel explains the manner in which some of these difficulties have been met.

Several other papers dealt with new forms of acetylene burners and the principles involved. The doings of the congress are reported in the *Illuminating Engineer* (London) for July. See also *Journal of Gas Lighting,* June 9 and *Acetylene* for June.

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* *Contractions used:*
*Elec. Rev.* *Electrical Review.*
*Elek. Anz.* *Elektrischer Anzeiger.*
*G. W.* *Gas World.*
*J. f. G.* *Journal für Gasbeleuchtung, etc.*
*Zeit. f. Bel.* *Zeitschrift für Beleuchtungswesen.*

# Miscellaneous News

DOVER, N. J.—Some adverse comment has been made on the action of the Common Council in granting a contract to the Dover Electric Light Company for the town's street lighting. While such comment may be made with the kindliest feeling, it is nevertheless frequently made without a complete knowledge of the facts in the case.

The electric lighting company offered seventeen arc lights with a total 20,400 candle-power at $86 per light, and 244 incandescent with a total of 6100 candle-power at $17. The gas company offered to replace the arc lights with two gas lights on opposite corners supplying a total of 2720 candle-power at a cost of $55; to put up gas lights with a total of 4880 candle-power, where the electric incandescents now are, at $18.50. The candle-power offered by the company getting the contract was three and one-half times that of the gas company. There was a saving of $1.50 on each incandescent light and a gain of five candle-power. On the corners the gas company offered two lights costing $55 and having but one-tenth of the power of the electric light at $85. As far as the quantity of light and the price is concerned it is apparent that the Council could not have made any other decision.

NEW YORK.—Consumers will no longer be forced to sign a contract with the companies for a year, but will be able to discontinue the use of electricity if they wish it at three days' notice. Some of the companies have also agreed to waive that clause in the contracts which makes it incumbent on the consumers to pay a certain amount every month whether they have actually used any electricity or not.

These changes have been made by the electric light companies as the result of the investigation which has been carried on by the Public Service Commission into the general situation. No order was issued by the commission, but the companies voluntarily accepted the Commissioner's ideas.

The Public Service Commission, denying the application of the Long Acre Light and Power Company to issue $10,000,000 of preferred stock and $50,000,000 bonds in order to establish an electric lighting system in the theatrical district, declared frankly that a monopoly of a public utility was not always detrimental to the public interests. The avowed purpose of the company was to enable it to raise enough capital to build a plant of sufficient size to compete with the Edison Company and thereby lower the rates for electric lighting.

SAN FRANCISCO, CAL.—Proposals for lighting the public streets and municipal buildings were received yesterday by the supervisors. The San Francisco Gas and Electric Company was the only bidder. Its bids were as follows: Sixty cents per 100 cubic feet for gas furnished public buildings; 4 cents per kilowatt for electric lights; 8.07 cents a night for each street gas lamp, and 20.712 cents per night for arc lights.

SYRACUSE, N. Y.—The Hammond law regulating the public lighting of Syracuse has gone into full effect, after having been upon the statute books of the State for one year. A requirement that did not become operative until recently was the one specifying that the volume of illumination of a street arc lamp must be equal to a 2000-candle-power open arc lamp. The lighting company, however, had not waited until the time limit to comply with this regulation, its lamps having been bolstered up to that standard by degrees for months past. To accomplish this it was found necessary to re-circuit its entire system, cutting the average number of lights on a current from seventy-five to fifty. While this work has not been entirely completed, it has been ascertained by actual tests that the requirement of 2000 candle-power of illumination is being given by each lamp.

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## *Contents of this Issue:*





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WESTERN REPRESENTATIVE: – G. G. PLACE, 430 West Adams Street, Chicago, Ill.

Entered as Second Class Matter January 13, 1907, at the Post Office at New York, N. Y.

# Give Your Eyes a Vacation

The summer vacation of the city dweller and worker has become as generally recognized as the Saturday half holiday; and both are the result of the intensity of modern urban life.

Of all the mental and physical activities none are subjected to a greater strain by reason of the strenuous life of the present time than the organs of vision. The results of this are plainly shown in the increase of defective and weakened eye-sight.

To look at any object requires visual effort, and is therefore a tax upon this most complicated and delicately constructed organ of the human body. All close vision, such as reading, writing, and the finer grades of mechanical work, are particularly wearing upon the eyes.

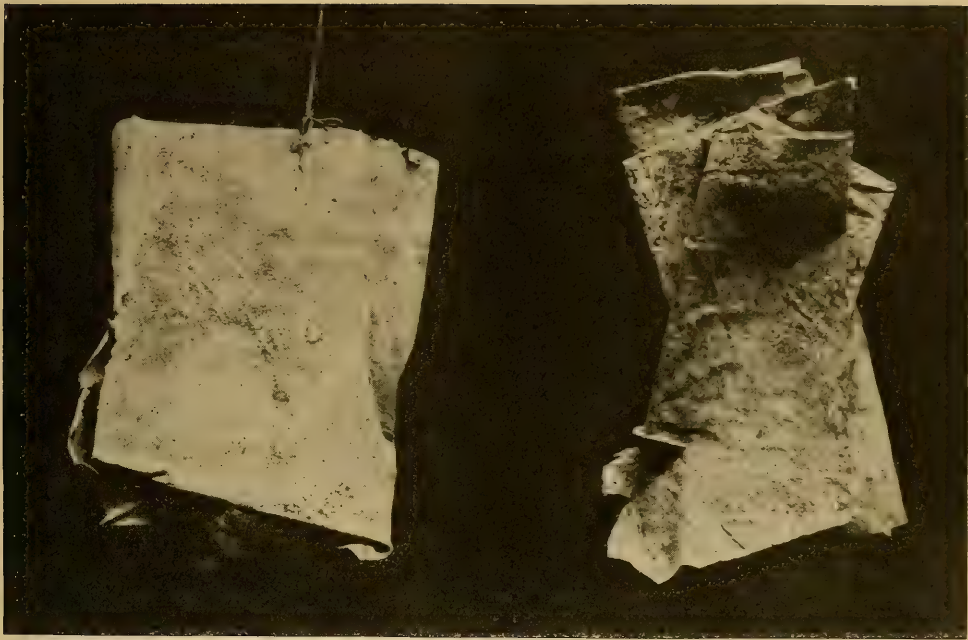
The eye, like any other organ, rests only when completely relaxed; and this occurs only when the eyes are closed, or not focussed upon, i. e., looking at, any particular object.

The savage, who rarely has occasion to use close vision, and who is habitually out in the open sun-light, is practically never troubled with weak or defective eyes; and there is no surer way of strengthening or restoring eyes that have been weakened by over-strain than a temporary return to the conditions of primitive man.

Leave books and printed matter of every description behind when you start on your summer vacation in the country. Leave your address with some trusted friend, and like Martin Luther, throw your ink-stand at the devil; your eyes are entitled to a complete rest, and have no business with the strain entailed by writing. Smoked glasses are a delusion and a snare: off with them. Give your eyes the benefit, while you may, of the natural, strengthening stimulation of open sun-light, with as complete freedom as possible from fixed vision.

Vacations are for the purpose of rejuvenating body and mind by a natural combination of rest and pleasant exercise. Of all things, see that your eyes get this vacation.

E. L. Elliott.



BREAD SHEETING OF THE ORIENT, USED ALSO FOR LAMP CHIMNEYS

# Lighting-Effect Curios of Other Lands

By L. Lodian.

Some curious lamp-shades there are in diverse regions of the universe. During a month's stop-over at Hawaii (en route to Australia) over a decade ago, the writer used to note how some of the natives used tree gourds, plain or tinted, as a shade over incandescent bulbs. That was in Honolulu,—the only town in the former Pacific Republic having a central station.

But the prettiest and uniquest lamp-shade the product of nature, is indisputably the tree-growing silk-lace tufts of the tropical forests of the upper Amazon, and interior Peru. This exquisite natural woven fibrous product is not confined, however, to Latin-America. Similar lace-yielding trees also exist in the Antipodes, some islands of Oceania, in the Ganges delta; and also in the historic Tigris-Eufrates valleys, about half a dozen trees in all. True, they are all in the tropic or sub-tropic zone.

The lace grows inside the branches; on stripping off the outer bark, the delicate looking fibre may be pulled out in sheets averaging a meter square (about 40 inches). The matrons in their homes make a host of uses of it, almost quite as many, in fact, as the Oriental does with his bambusa plants, or the American Indian does (or did) with his birch-bark. It adorns the table for lamp-shades, either in branch-tuft form or made up from the pulled-out sheets; as doilies, anti-macasars, bridal-veilings (half a dozen meter square sheets being united to form a singularly beautiful and appropriate nuptial vestin), communion veils, zephyr-like portieres, curtainings, mantillas; and so on through a score of other uses. The specimen illustrated is only a small pocket-example, but is sufficient to give a fair idea of the meter-long lengths. Moreover it is the only exhibit of the material im-

mediately available for depicting here.

The same regions of Latin-America produce in great numbers the fire-flies of such (momentary) luminosity that it is possible to read print thereby, although of course not practical for steady reading. Many of the haciendas and planters will keep three or four of them under inverted glass vases in their offices and outbuildings, for (on slight agitation) yielding a momentary glare sufficient to grope one's way, or feebly locate an object in the dark.

LAMP SHADE MADE OF NATURAL TREE-LACE

During trips over a score of years ago, through the Southern Republics from Mexico to the Plata, I have sometimes seen them so numerous flitting and sparkling from bush to bush in the dark as almost to make one believe the bush was being slowly consumed by a coruscation of orange-red incandescent twinklings. Especially as, in the solitude of the tropical forests, the noise made by the fireflies resembled slightly the crackling of burning furze.

The Paris weekly "La Nature," contained a few months ago actual photographs of books taken solely by the light yielded by placing a few of the fireflies thereon, and the book-titles were distinctly readable. Of course, the exposure was a lengthened one. Being always interested in the phenomenon of natural illumination, as well as the science of artificial lighting, I have ever considered the fireflies of Tropical America one of nature's most beautiful creations, on a small scale.

In the larger American cities, there are a few select lighting-expert firms who make a specialty of giving antique or quaint effects to the environments of modern illumination. Every source on the history of lighting has been ransacked for designs and details and data various. It must be admitted that their "reconstruction" of Medival effects are highly creditable, and apparently there is nothing more for them to follow up in ancient ideas, yet I think as an observant trader, I can still tell them something they don't know, yet "as old as the hills."

In the Kibitka (folding trellis-work tent) of the Central Asiatic nomad, you see a peculiar translucent lantern for steadying the tallow-fat container light from air currents. It looks like parchment, or paper, but is neither. It is simply bread—a strip torn from their bread-sheeting, and improvised around the lighted container. In the bazars of the Kalifats, this bread-sheeting is sold like cloth, by the 40 inch yard, or meter, and the lengths vary from three to ten meters. The width is about one meter. It is always sweet-tasting, the nomads preferring a carbohidrat to salt in their bread; the sodium would aggravate the agony of thirst in the parched deserts. So the wheat-flour is compounded, not with water and salt, but

DRIED FRUIT SHEETS USED FOR MAKING COLORED LANTERNS

simply the expressed pulp of dried sultana raisins. This renders the bread-sheeting—which is no thicker than tough brown paper—ever pliable, and it can be crushed up in the hand without leaving a crease even.

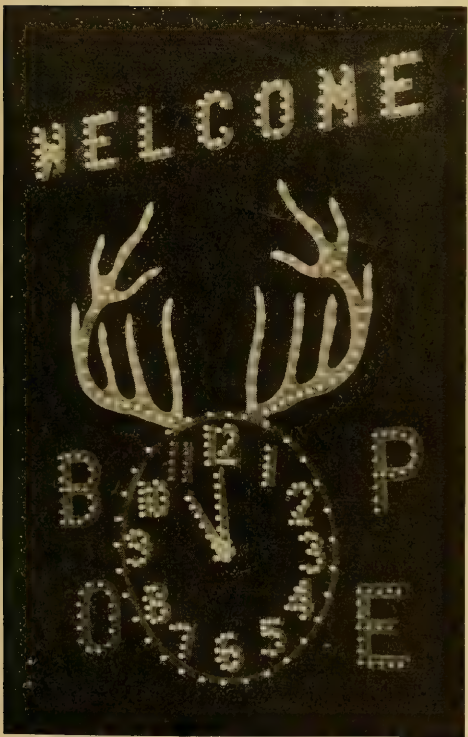
Its primary use is of course as a food; its secondary uses are multiple. It is curious how the brain of a nomad develops ingenuity when forced to do so. Lacking a metal container for his fat-light, he deftly extemporizes a seamless flush-sided little vessel of this bread and encloses in it a lantern of bread. He will also use it as a makeshift temporary windowing, and as an awning against old sol's rays. He will use it, in lieu of paper, for scribbling his Arabic memos on; and the merchants in the bazars will use it as a folio cover to keep together their cahiers of papers. It is always dry and cleanly to handle, and for use as bread may be preserved for years. The bread-sheeting is never baked, just sun-dried.

More as fantasy than for practicability, the nomad will sometimes use the pure fruit-sheeting as a lantern. This is the pressed-out pulp of apricots, sundried in big sheets; and, by employing different fruit-sheetings, a unique gala-effect is obtained in lantern illumination; and the kibitka-dweller in the desert celebrates his ramadan with a queer lighting eclat that is to his credit.

Then, at a pinch, when hungry, he will go round chewing-up the fruit and bread tallow-containers and lanterns!

The use of these peculiar food-lanterns is all very well in a dry climate; if rain soaks them, they collapse. In fact, the Arab uses his lantern as a "family barometer"; when it feels moist, he knows that the air is so saturated with humidity or indicative of the approach of unsettled weather, that he adapts his working arrangements accordingly.

## Welcoming the Elks to Fort Worth, Texas




A LUMINOUS WELCOME

It is better to shine by reflected light than not to shine at all. Not long ago the Elks held a convention in Dallas, Texas. Fort Worth is a town some thirty miles distant, which, as distances go in Texas, makes it a very near neighbor; consequently its citizens showed their neighborly feeling by welcoming the Elks to Fort Worth. One of the means of expressing this welcome is thus described by a correspondent.

"The photo shows a decorative piece which we installed in this city during the Elks Convention; the Convention was held in Dallas, Texas, but owing to the close proximity of that city to Fort Worth, we had almost as many visitors as Dallas. The business men anticipating the event contributed to defray the cost of the decorative pieces shown. From the top "Welcome" to the bottom of the clock dial it measures 34½ ft.; at its widest part, 18 ft.; diameter of clock, 10 ft. Four hundred and twenty-seven 16 c. p. lamps were used in the entire piece, all white frosted lamps, with the exception of the letters B. P. O. E., and the figure 11 on the clock dial. These lamps were natural colored, purple glass.

FIG. 1

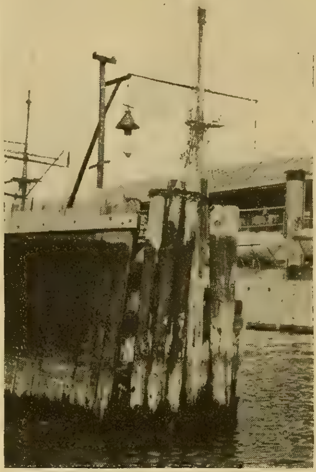


FIG. 2

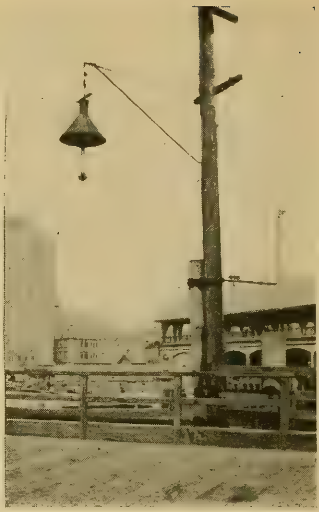


FIG. 3

# Street Lighting Fixtures—Some New York Examples

By H. Thurston Owens.

Makeshift street lighting fixtures are slowly disappearing from the streets of American cities, and in their place there have been many handsome installations.

Probably one of the most unsightly fixtures which have disgraced, rather than graced our thoroughfares has been the Open Arc, with its large hood, and usually supplied from an overhead circuit. One of these relics is shown in Fig. 3 being on private property at the foot of 23d Street, New York City. The Ferry Company operating here also use arc lamps for the purpose of signal lamps, the globes being white, red and green, one being shown in Fig 2.

An improvement upon the older type is shown in Fig. 1, where the open arc has been replaced with one of the enclosed type, with opal inner and clear outer globe and the base of the post is of cast iron The wooden columns are gradually being replaced with iron and the lamps are suspended from a crook, as shown in Fig 4, the distance from pole to lamp being 18 inches

This lamp is in Battery Park, and is one of the few on the Island of Manhattan supplied from overhead service.

This shaft and crook in connection with a larger base is the style in general use in the residence districts. See "Illustrated Engineering Magazine," '08, pp. 139.

When lamps are located in the center of the roadway a type similar to the old style is used, being illustrated in Fig. 6, known as the Lyre Pattern. This style is in vogue in Europe, especially on Boulevards where the lamps are located upon Isles of Safety, one of the best examples being Boulevard Capucines, Paris. See "Illuminating Engineer," Nov. '07.

Upon some of the downtown streets the elevated railroad has been erected over the sidewalks, and in order to locate the lamps so that they will light effectively it has been found necessary to construct a large number of fixtures, each of a special design to suit the individual case.

One of these lamps is illustrated in Fig. 8, the base being the same as shown in Figs. 4, 5 and 6, but the column and arm are of special design, conforming as near as possible to the general lines of fixture shown in Fig 4.

For suburban, series arc lighting, from overhead circuits, the lamps are usually suspended quite close to the pole, carrying the transmission line, although a number of mast arms are in use.

FIG. 4

FIG. 5

FIG. 6

A rather unusual example of this latter type is shown in Fig. 1, the arm being of wood and ranging from 14 to 17 feet in length. These are to be found on Staten Island, which is the Borough of Richmond.

Practically the same idea has been followed in the design of the lamps erected upon the Ocean Parkway, Brooklyn, shown in Fig. 9. In the latter case the lampposts are handsome iron castings, supplied from underground circuits. The object of these long arms is to bring the lamp beyond the trees, thus avoiding heavy shadows on the roadway, where they would be most objectionable.

An improvement upon these posts is found upon Seventh Avenue, Manhattan, where a very large installation is nearly completed. This street is a Boulevard extending from the north end of Central Park to the Harlem River, a distance of over two miles.

The street is laid out with center plots in which trees will be planted to conform with the sidewalks which are lined with immense elms.

The blocks are 260 feet long, and there will be two lamps at each intersection upon diagonal corners, of the type shown in figure 7, and at the middle of each block in the center plot is a lamp similar to the one shown in Figure 5, although somewhat taller.

The feature of the corner posts lies in the fact that they are adjustable to the extent that both shaft and arm can be made of the desired length without materially altering the general lines of the fixture.

All of the globes used in this installation are dense opal, and the general absence of shadows is very noticeable.

That the interest on this subject is not confined to New York City is well illustrated by the reports from various cities throughout the country. In the August, 1907, number of "The Illuminating Engineer" the author called attention to the conditions in some of the larger cities and in the short space of time which has elapsed there have been reports of great progress.

Buffalo, N. Y. A contract has recently

FIG. 7

FIG. 8

FIG. 9

been awarded to replace all of the open flame gas lamps with those of the mantle type.

Chicago, Ill. Lamp-posts made of concrete have been erected by one of the Business Men's Associations, on one of the principal streets, and in another district very complete plans are under way for the lighting of a large number of downtown streets.

Denver, Colo. Another of the business streets is to have ornamental lighting, and the post to be used is of a much lighter type than the present installation on Sixteenth street.

Salt Lake City, Utah. Mantle gas lamps were recently installed for trial, and probably a number have been erected ere this. Additional lighting here is very badly needed.

San Francisco, Cal. Plans have been approved for a combination light and trolley pole similar to those in use in Denver.

Los Angeles, Cal. Additional lamp-posts of the ornamental type are to be installed.

# Diagnosis under Artificial Light:

## Its Difficulties and a Solution of the Problem

By A. Cressy Morrison.

Most physicians recognize the difficulty of accurately judging the condition of tissues by means of artificial illuminants. The difficulty has, however, usually been accepted as inevitable. Until recently, no artificial illuminant has been known which has the balanced spectrum of sunlight, and so, where diagnosis has been necessary by means of artificial illuminants, the physician has done the best he could, occasionally correcting his opinion after a verification of the examination by daylight.

The eye through all ages, has adapted itself to see by daylight. Its evolution has been wrought in harmony with the solar spectrum. The seven colors of the solar spectrum have given intensity; combined, they make white light. All artificial illuminants, save acetylene alone have an excess of one color or another. City gas light has an excess of red, kerosene an excess of yellow and red, the Welsbach burner an excess of green, the arc light an excess of violet, the incandescent an excess of orange and red. Acetylene, on the other hand, has the seven colors in such intensity that compared with sunlight, the difference is negligible. The excess of one color or another in artificial illuminants upsets the judgment of the physician, and is bound to have an effect upon the validity of a diagnosis. If

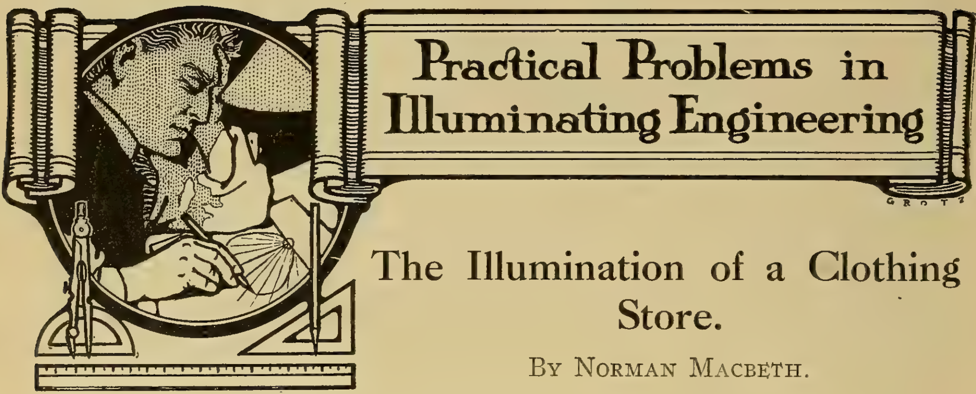
the eye has adjusted itself to see best by daylight, then, under daylight, colors have their normal values, and the mind, trained and adjusted to base its conclusions upon what the eye reports, can only with the greatest difficulty make the proper additions and deductions that an accurate conclusion may be reached. How can the mind say to the eye, which reports accurately what it sees, "You are deceived. The light by which you see that tissue is a distorted light. Therefore the color you report is not the real color of the object as seen by daylight. It is not so red as you say it is. Therefore the inflamation is not so bad, therefore the case is not so serious."

We seldom think of it, but there is literally no color. The blue sky is not blue, but light makes it appear so. Light, falling upon particles of matter, is diffused, but space, where there is no matter which will hold light, is absolutely black. The silver moon is matter, and this matter reflects the light of the sun to us. Therefore the moon is visible. The green grass reflects to our eye the green rays which come to it from the sun. Speaking broadly, if it could not reflect the green rays and could not reflect any other, the grass would be black. Color, therefore, does not exist except as the waves of light are thrown back into the eye from the object upon which we look. Waves of a certain length have a certain color. The slowest rays are red, and the quickest visible rays are violet. If an object absorbs and neutralizes all the rays or waves except the very long ones, and these are thrown back to us, we say the object is red. All light and color and every wave has ceased but red. The application of this to diagnosis must be immediately apparent. If a tissue is examined under city gas light, in which the spectrum shows that there is a large excess of red rays, then a tissue, which in daylight would be normal, would, under city gas light, appear to be much redder than it really is. The eye accurately reports the excess of red color, and as inflamation increases the ability of a tissue to reflect red rays, the mind instantly says the tissue is inflamed, while, as a matter of fact, it is not the tissue which is inflamed, but to put it in a curious way, it is the light which is inflamed. It has an excess of red. If a physician is examining tissues under a green light, the tissues have an abnormal and ghastly appearance. Green light, if thrown upon a red surface in sufficient purity, leaves the red without light, therefore, the red appears black. If green rays fall upon a surface which in daylight would be red, the surface cannot respond; therefore, it has no color, and in the absence of color, it is black.

It is unnecessary to go further in this line of thought, as physicians are already fully aware of the difficulties of proper diagnosis with artificial light. There are, however, some phases of the subject which are not always given consideration. In the case of an examination of the blood, to discover an anaemic condition, it should be remembered that, if examination under artificial illuminants is made, with an illuminant giving an excess of red, the condition of the blood appears much better than it really is, and under an illuminant which is deficient in red, the apparent condition of the blood is much worse than it really is.

So important is accurate judgment to the physician and the surgeon that the adoption of acetylene, which is really daylight at night, in the operating rooms of hospitals is being seriously considered. The spectral similarity between acetylene and sunlight has only been recently brought to the attention of physicians, but its advantages were immediately recognized.

Acetylene is within the reach of every physician, and especially those in the country, as an individual household generator is now made by manufacturers in almost every city, which will produce acetylene for lighting an entire house, at a cost, candle power for candle power, which compares favorably with city gas at a dollar per thousand cubic feet. The apparatus and piping are not expensive and can be put into any house by a good plumber in two or three days without disturbing furniture or walls. Over 150,000 individual installations are now located in country homes throughout the United States, so that its safety and utility are completely demonstrated. Many physicians have adopted acetylene as the common illuminant for their homes, and find it of inestimable value in their practice, and of great benefit to their patients.




# The Illumination of a Clothing Store.

By Norman Macbeth.

An example of effective illumination is that recently installed for MacDonald & Campbell, an up-to-date clothing and men's furnishing house at 1334-36 Chestnut St., Philadelphia.

The question of lighting has been taken up many times by this firm, and several changes have been made. In 1905 they began to change over from 5 am. to 6¼ amp. arcs. changing first the lower floor and finally last year completing the change practically throughout the three floors, and although the resultant illumination was not entirely satisfactory, the changes are quite noticeable in the monthly bills received from the Company supplying current, same having increased very considerably as shown by the following statement of current percentage increases from Dec., '02, to Aug., '08.

| | | | | | |
|---|---|---|---|---|---|
| '03 | over | same | period | '02, | 25% |
| '04 | " | " | " | '03, | 20% |
| '05 | " | " | " | '04, | 14% |
| '06 | " | " | " | "05, | 37% |
| '07 | " | " | " | '06, | 32% |
| '08 | " | " | " | '07, | 5½% |
| '07 | " | " | " | '06, | 32% |
| '07 | " | " | " | '05, | 81% |
| '07 | " | " | " | '04, | 105% |
| '07 | " | " | " | '03, | 148% |
| '07 | " | " | " | '02, | 210% |

The periods taken being from Dec. to Dec., excepting 1908, which is Dec., 07, to Aug., '08.

The increases up to 1905 are probably due equally to increased use of current and higher meter efficiency. During 1906 arc lamps were changed to lamps of higher amperage and more lamps installed, also in 1907, changes were made in the arc lamp installation using 6¼ ampere arcs practically throughout the three floors. It is just possible that some of these increases may be explained by the percentage of cloudy days each month or each year as compared to those of some other month or year, in accordance with statements furnished by many companies, giving condensed Weather Bureau reports as a panacea for high rates, unsatisfactory service, poor voltage regulation and generally as an invaluable aid to the Complaint Dept. Or perhaps as a Central Station man explained, "During the period when our load approaches the peak on our already rather heavily loaded lines, to protect ourselves from the 'hot hairpin' effect which consumers are not generally slow to notice, we raise the voltage above normal. Of course, this means increased total charges, but with incandescent lamps the watts per c. p. are greatly reduced, and the lamps are consequently burning at a higher efficiency. If consumers would turn off a sufficient number of lamps equivalent to the increased candle power, there would be fewer complaints about excessive and unaccounted for increases in charges."

Third Floor:—On this floor nine arc lamps were in use, at outlets 18 to 20 feet apart in the front and 14 feet in the rear. Six lamps were used in the front and three in the rear section. In the

FIG. 2

rear, on the floors above the first, the light shaft shown by the outline of skylight on plan Fig. 2 cuts through reducing the floor space. As the ceiling was low a short close setting 4-light fixture was used with 100 watt tungsten lamps in front section and 60 watt tungsten lamps in the rear, using the old outlets. The arc lamps on this floor were measured individually and ranged from 800 watts maximum to 600 watts minimum, the average being 657.

Height of ceiling, 11′ 8″.
Height to lamps, 10′ 6″.
Total sq. feet area, 3160.
Total watts arc lamps, 5900.
Total watt tungsten lamps, 3120.
Reduction in current, 47%.
Watts per sq. ft., .987.

Second Floor:—On this floor the conditions on the third floor were duplicated in arc lamps and general layout with the exception of the ceiling height. A fixture similar to that used on the first floor, (as shown by the photograph), was installed on a shorter chain.

Height of ceiling, 14′.
Height to lamps, 11′.
Total sq. feet area, 3160.
Total watts arc lamps, 5900.
Total watts tungsten lamps, 3120
Reduction in current, 47%.
Watts per sq. ft., .987.

The illumination measurements were not taken in either of the above floors, but same would not average less than 5 foot candles, the illumination being very satisfactory, as it was through the work done on the third floor that the order was given to proceed with the rest of the building.

First Floor:—The main clothing and furnishing sales department on this floor was formerly illuminated by eleven 6¼ amp. arc lamps with porcelain reflectors and opal inner globes only, at a height of 9 feet from floor to arc. Each arc was replaced by a 4-light chain fixture, as shown by photograph Fig. 1, using 100 watt tungsten bowl frosted lamps throughout. Holophane 7391 reflectors were used on the fixtures on all three floors. This reflector with a 100 watt tungsten lamp has the

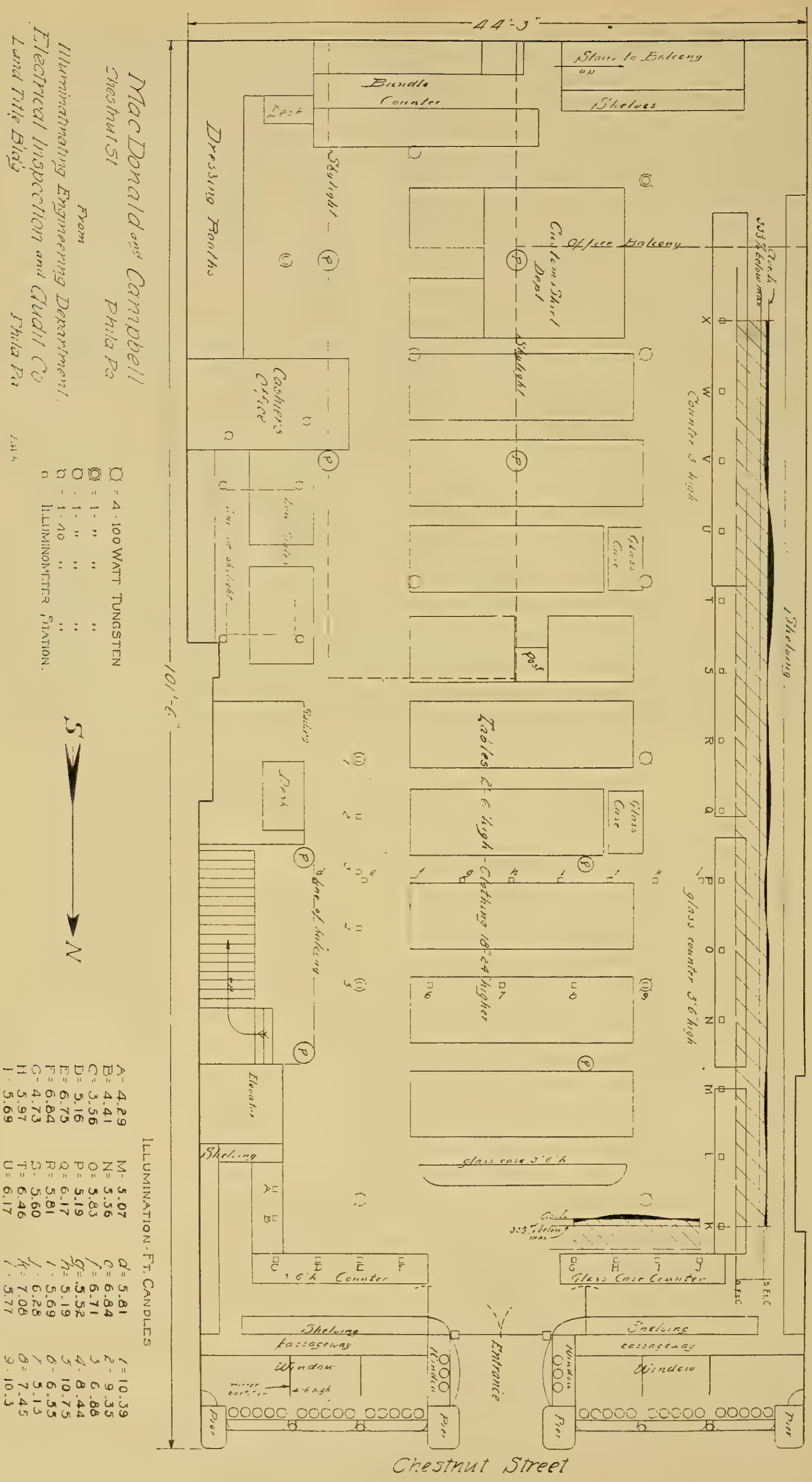

MacDonald and Campbell
Chestnut St Phila Pa
From
Illuminating Engineering Department.
Electrical Inspection and Audit Co
Land Title Bldg Phila Pa
4-100 WATT TUNGSTEN
ILLUMINOMETER STATION.
ILLUMINATION-FT. CANDLES
A-4.29 B-4.41 C-3.56 D-5.16 E-6.75 F-6.84 G-4.73 H-3.97 I-5.69 J-4.86 K-4.95 L-5.35
M-5.07 N-5.56 O-5.83 P-5.19 Q-6.17 R-5.81 S-5.60 T-6.46 U-6.17 V-4.87 W-5.19 X-5.15
a-5.81 c-6.84 f-6.71 g-5.52 h-5.19 i-5.69 j-6.28 k-7.08 l-5.77
1-10.39 2-9.35 3-6.88 4-8.44 5-10.75 6-6.55 7-5.13 8-7.45 9-10.3
44'-3"
101'-6"
Dressing Rooms
Cashier's Office
Bundle Counter
Desk
Skylight
Custom Shirt Dept
Office Balcony
Stairs to Balcony up
Shelves
Counter 3' high
Shelving
Glass Case
Post
Tables 2'6" high - Clothing 18"-24" higher
glass counter 3'6" high
glass case 3'6" h
Elevator
Glass Case Counter
Counter
Passageway
Window
Entrance
Pier
Chestnut Street
S
N

FIG. 2

maximum candle power at 38 degrees. Special holders were used, spun from heavy metal for the form H position, sweated securely to the socket shells, having the set screws for attaching the glass which all porters understand how to handle. They may perhaps break a reflector by setting the screws up too tight, but they are not so liable to pull holders or sockets off the fixtures.

These fixtures were hung at a height of 12 feet, and are well out of the line of vision, enabling those using the light to work with what is undoubtedly an easier condition for the eyes. Though the intensity is high, the distribution is excellent, and the fixtures are a sufficient distance from the ceiling to prevent that spotted light and shadow effect so noticeable where short fixtures are used. Considering the distance between outlets, the fixtures as hung are above the critical point of the light distribution of the reflector used, securing a remarkably uniform distribution as reference to curve of intensity on counter shows. The maximum variation being but 18% from the mean on this plane—this has been shown graphically on floor plan Fig. 1—is a smaller variation than the eye can appreciate.

In "The Lighting of a Shoe Store," described in the March number of the 'Illuminating Engineer," a variation on the plane of 33 1-3% could not be detected by the observer without an illuminometer. The line 33 1-3% below the maximum is shown on illumination curve Fig. 2 indicating how much greater the variations might have been and still meet the specifications of uniform illumination.

The higher illumination intensity opposite stations S to U is undoubtedly due to the fact, that three of the rear fixtures in the east row are four feet closer to the west counter than those in the front part of the store.

A Sharp-Millar Illuminometer No. 2 (standardized on a bar photometer before and after the tests) was used, and upwards to 200 observations taken at the stations and with the results indicated on plan Fig. 2.

It is worthy of note that while all our calculations so far as uniformity of distribution is concerned, were borne out by the observed results, the intensities were higher, but unfortunately sufficient data was not taken to permit conclusions as to the co-efficient of reflection. It is, however, no negligible quantity, the ceilings and walls being finished in light buff. Measurements were taken on the plane at the height of 4 feet d to 1, and are on the minimum line across the room; 1 to 5 show the maximum under fixtures and 5 to 9 the maximum across the room between fixtures. In the neckwear and hosiery departments many color values which were badly distorted by the excess of blue and violet of the arc lamps are now reported as satisfactory and nearer their true values. While the illumination from the tungsten lamp is far from daylight, its contribution to that part of the spectrum best appreciated by the human eye cannot be overlooked and should not be under estimated.

The photograph of this floor Fig. 1 was not retouched, the lens used was stopped down to F-32 and 7¼ minutes exposure given.

SUMMARY OF FIRST FLOOR.

Height of ceiling, 18′.

Height to lamps, 12′.

Height of test plane, 4′.

Height of lamp above test plane, 8′.

Total sq. ft. of floor, 3780.

Total watts tungsten, 4600.

Number of lamps 100 watt tungsten, 46.

Total watts previous installation, 7547.

Arc lamps, average 657 watts, 11.

8 c. p. lamps carbon, 4.

16 c. p. lamps carbon, 4.

Reduction in current, 39%.

Number of test stations on counter, 14.

Total number of test stations, 42.

Mean foot candles on test plane on west counter, 5.58.

Maximum variations below mean on counters station U, 11%.

Maximum variation below mean to counters station U, 11%.

Average foot candles throughout store, 6.55.

Watts per sq. ft., 1.217.

Foot candles per watt per sq. ft., 5.2.

Watts per sq. ft. per ft. candle, .192.

MacDonald & Campbell appreciate that the intent of a window display is to sell goods, and those windows only are good which brings in customers, figuratively draw them through the windows. Displays that fail to make sales through being improperly illuminated, fail from a

FIG. 3

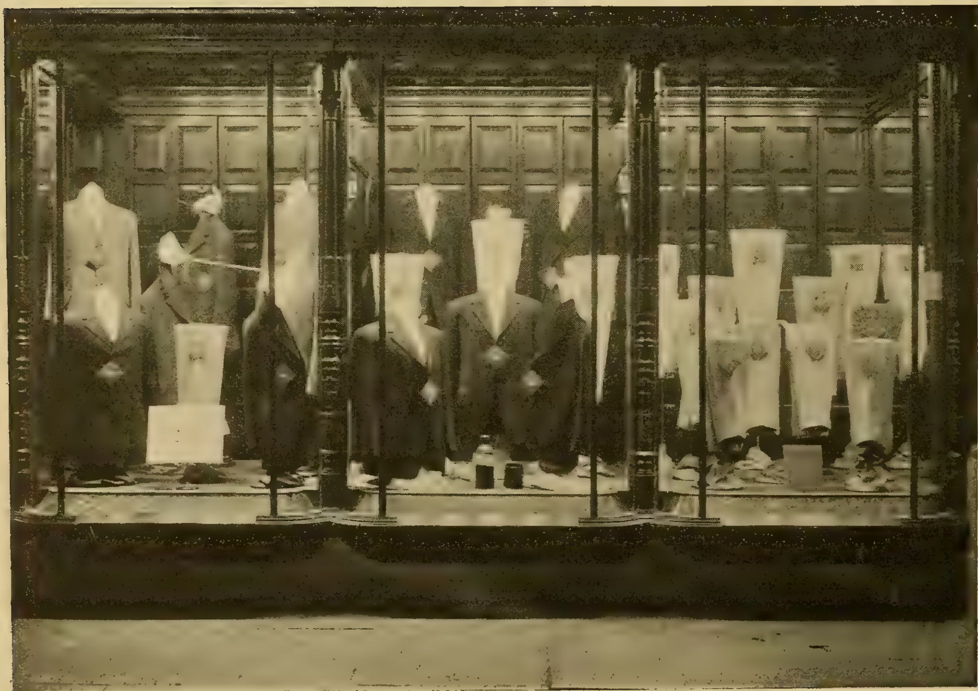


FIG. 4

business standpoint. These windows being in the neighborhood of the largest office buildings in Philadelphia, and the heart of the better class theatre district, contribute to sales from before sundown to midnight every night except Sunday, mail orders being received daily for goods noted in the window display.

"Our windows never have been satisfactory," although they were above the average, results did not meet this firm's standard. The lighting was from trough reflectors in the top front of each section with vertical trough reflectors on each side, 7 reflectors with a total of 44-16 c. p. lamps in each of the front windows. In the window shown in Fig. 3, the vertical troughs were of little value beyond the nearest form which really received too much light, making more noticeable the lack of sufficient illumination on the bulk of the goods in the window, which the top reflector alone could not cover. This result was not so noticeable in the furnishing goods window where the reflection values are much higher. The average observed intensity in these windows was 10 foot candles.

In the calculations for these windows a specification curve H, B, C, D, E, F, G, Fig. 5, was plotted, the curve of the reflector used is shown A, B, D, K, Fig. 5. This was secured by using a 6060 Holophane with a cut of 15 degrees on the bottom with a holder giving a position about ¼″ less than the form H. It was known that a considerable portion of the flux from the minimum side of the curve E, F, G, Fig. 5, would be reflected from the plate glass, building up the illumination in the front. That this result was secured is shown by the curve taken on the floor of the window with the illuminometer, all the values being in.

A point worthy of note is the considerable increase in illumination in the windows as measured by illuminometer over that calculated from the polar distribution curve, the calculations without any addition for reflection being approximately a third lower. A flux calculation checking within 5% is secured by the mean of the flux to 40% on the maximum side and 20% on the minimum, giving 146 lumens per unit, the lumens actually effective being 153.6, the latter figure is the result of an average intensity of 30 foot candles,

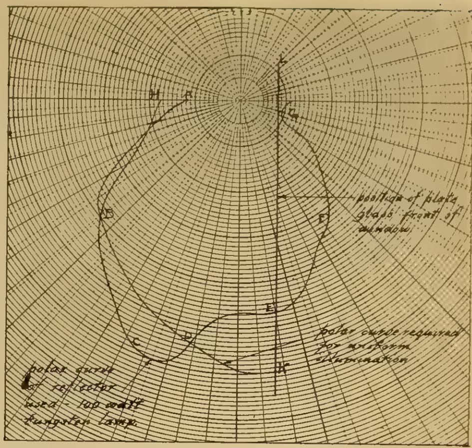



FIG. 5

as measured by the illuminometer, secured from 5 lamps on the floor plane of 25.6 square feet. The maximum secured, 42 foot candles, together with the average, may seem excessive; however, from measurements taken outside at an approximate height of 5 feet and a distance of 4 feet from the window, the intensity reaching the eye is not excessive, the coefficient of reflection in the clothing window being low. An equal quantity is reflected from the furnishing window using 3 lamps per section only. The circuits in the six sections are arranged separately with a control of two or three lamps per section as may be desired. In this way the illumination may be varied according to the goods used, thereby preventing a section having lighter goods commanding attention at the expense of the others. From an experiment made with one section with the goods removed, it was shown that the illumination on the sidewalk is largely due to the light reflected from the goods.

Some difficulty was experienced on account of the deck of the windows being but 8′ 6″ above the sidewalk, and because of the peculiar construction as shown in detail Figs. 8 and 9, lamps could not be brought nearer than 15″ to the front of the window. It was also necessary to install the new equipment and change over from the old system, without disturbing the window displays; as may be noted in the 'before and after' photographs Figs. 3, 4, 6 and 7, the same goods being displayed with the single exception of the east section of the west window, the gen-

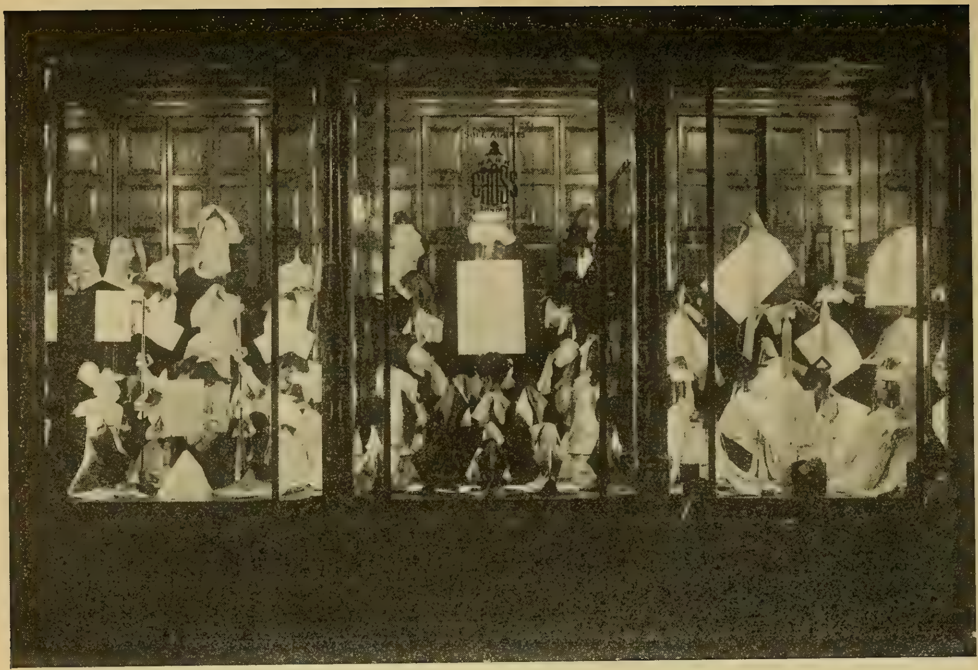


FIG. 6

FIG. 7

eral character of the goods in this section being similar did not interfere with a fair comparison in the photographs of the two methods of illumination The photographer failed to judge the illumination values in the new windows, the instructions being to give each installation the same time and stop, Figs 3 and 6 were given 2 minutes with F-11, which exposure was found to be too long for Figs. 4 and 7—the stop was reduced to F-16 with exposure of 2 minutes. The photographs Figs. 4 and 7 were taken on the night following the taking of Figs. 3 and 6. Attention should be directed to the even intensity of illumination on all parts of the display, the shadows are sufficiently defined to bring

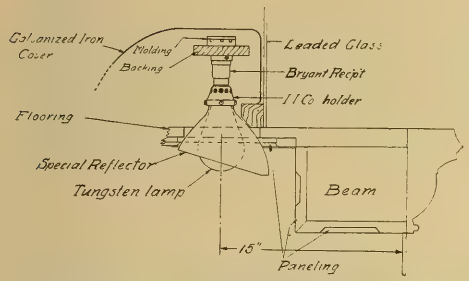



FIG. 8


FIG. 9

out the detail and are in the direction most natural for the observer.

### Summary of the Front Window.

#### Installation.

Height of windows, 7′ 3″.
Height to lamps, 7′ 2″.
Height of lamps above test plane, 6′ 7½″.
Total watts tungsten lamps, 3000.
Number of lamps 100 watt, 30.
Total watts previous installation, 4400.
Number of lamps 16 c. p. 50 watt, 88.
Reduction in current, 32%.
Maximum foot-candles in windows, 42.
Average foot-candles in windows, 30.
Watts per sq. ft, 20.
Watts per sq. ft. per candle, .666.

#### Summary.

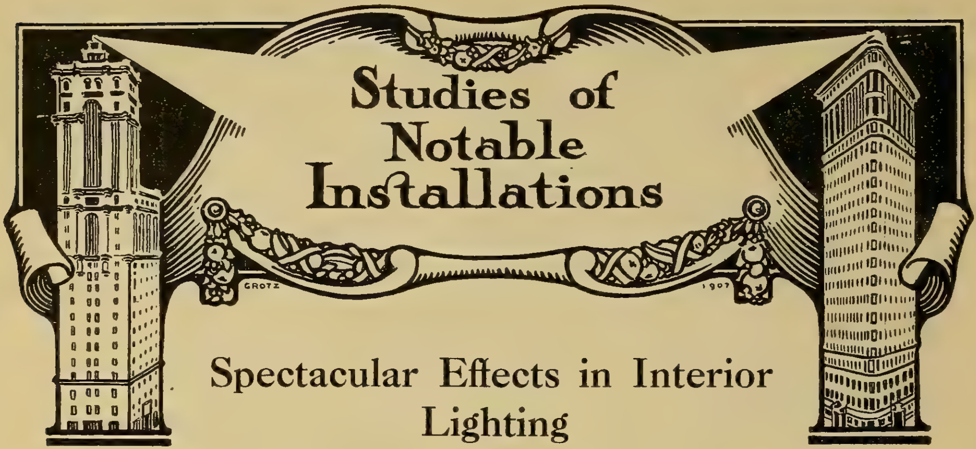
Grand total wattage of tungsten lamps, 14,440.

Grand total wattage of lamps removed, 24,247.

Total current reduction, 42%.

Cost comparison of this installation should be based on current cost plus lamp renewals. The labor cost for replacing lamps and cleaning reflectors will be offset by that required in cleaning and trimming the arcs, and carbon costs will easily cover glass breakage.

From meter readings taken daily from the completion of the installation the net reduction is approximately one-third under the same period of 1907. However, as a number of 16 c. p. carbon filament lamps are used many hours per day in the basement some remaining on continuously, they hold the percentage down when considered with the comparatively small store load used at this season, the winter months being more than double July and August without any change of conditions in the basement. The net reduction on the year's bills will easily exceed 40%. This saving will be sufficient to write off the entire investment for installation on the three floors and windows within one year. Lamp renewals on the basis of 800 hours life will amount to approximately $300.00 per year at the present prices as supplied by the Philadelphia Electric Co., viz., $1.50 for 100 watt, $1.25 for 60 watt and $1.00 for the 40 watt lamps. There is no guarantee as to life. Lamps ordered in quantities will be screwed into the sockets, are lighted and signed for.




# Spectacular Effects in Interior Lighting

Someone has remarked that you can dine publicly in New York according to the manners and customs of every civilized nation under the sun except America. No matter what may be the country of your birth, the particular dishes that are characteristic of your native land, served probably by natives of your country, and to a greater or less extent amid surroundings including the guests themselves, that are more or less strongly reminiscent of your native heath, may be found if sought for. The single exception is the American countryman who seeks the simple pies and cakes, bread and biscuits, vegetables and meats, which his mother used to make when he lived on the farm; for these he will search New York restaurants or hotels in vain.

But the inhabitants of the metropolis, as well as the stranger within her gates, is usually seeking novelty rather than that with which he has been long familiar; and novelty and picturesqueness he can certainly find in abundance. Recognizing this fact, restaurateurs, especially in recent years, have vied with one another in their efforts to produce novel and spectacular effects in the fitting up of their eating places. Eating has been treated as a fine art, and given a setting designed to minister to the other artistic senses as well as the gastronomic. To such an extent has this been accomplished in some cases that the restaurants are veritable show places, often patronized, and rightly so, for what is to be seen quite as much as for what is to be eaten.

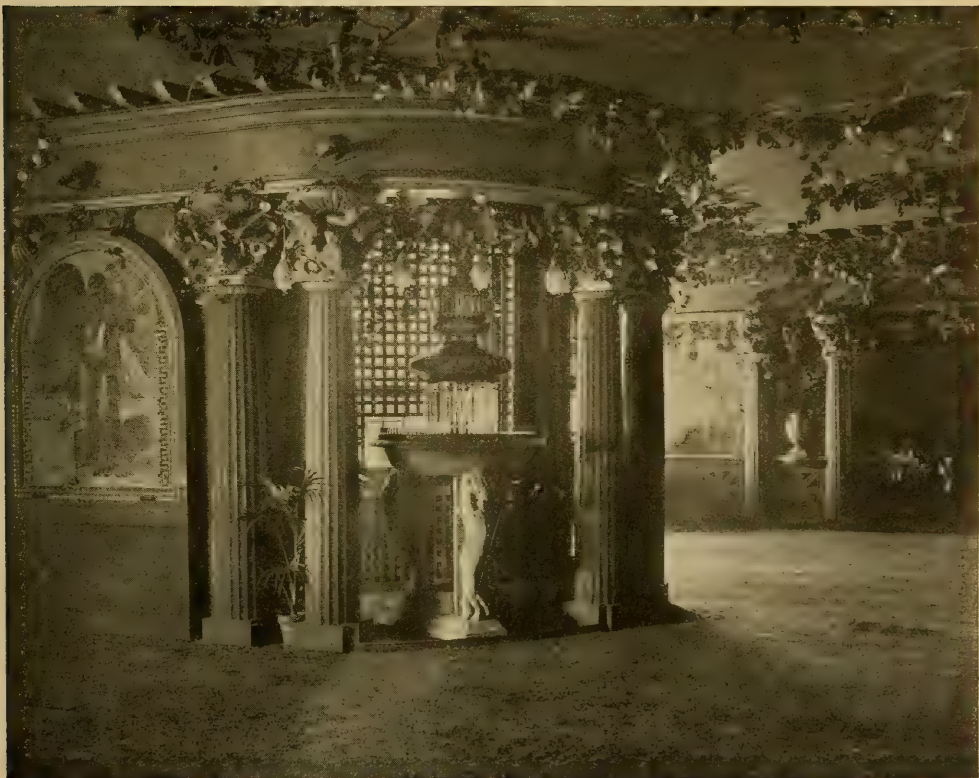
Among such restaurants is the one known as Archambault's, located on Broadway at 102nd Street, which is three miles from the up-town terminus of the section of Broadway known as "The Great White Way."

The restaurant is divided into two rooms with open doorway between; there is an entrance from the street into one of these rooms. It is in gold and brown, the decorations being very simple, consisting of tapestries and lighting fixtures; the latter are mostly mosaic glass balls of varied hues, though frosted incandescents with beaded fringe are also used.

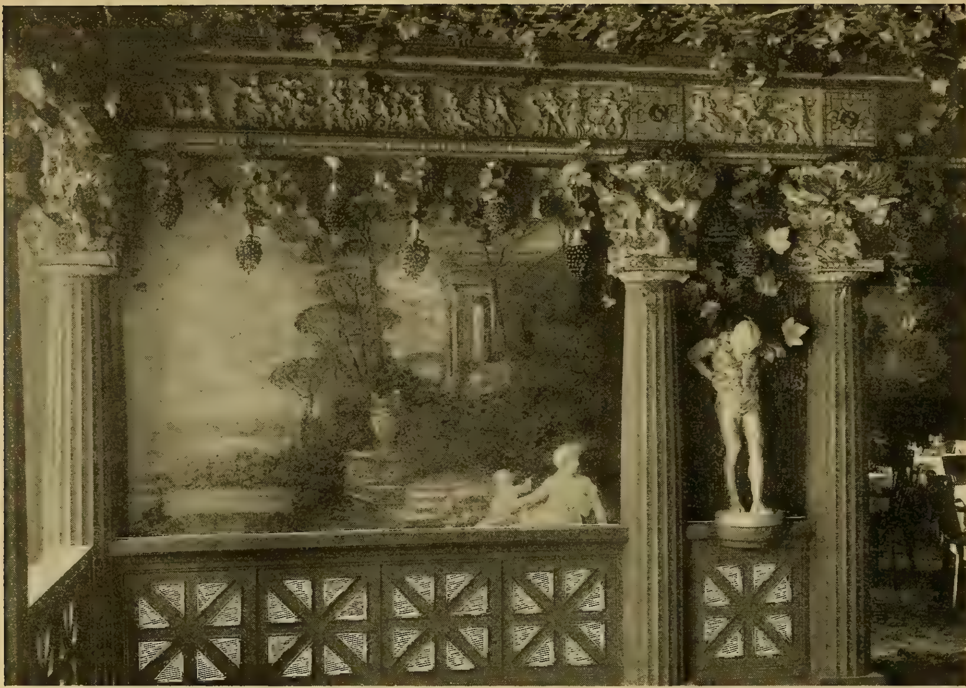
The room has the appearance of being much larger than it really is, as the side-wall is mirrored, and the arbor effect has been more successfully carried out than the illustrations show. The ceiling is latticed on one side, and the other papered a rich blue. The walls have illuminated mural decorations, the subjects being taken from Greece and Rome. Entwined around all of this splendor is the vine of the grape, and needless to say the fruit is quite ready to pick, and glistens, not from the morning dew, but because of tiny electric light bulbs inside of each bunch, while other lamps are hid among the leaves.

The ball of mosaic glass to the right in the illustration on the front cover contains electric lamps and silk lanterns from Japan sway in the breeze from the electric fans. A beetle, green and glowing, larger even than madame's hat, is swaying softly above. Tubular

WHERE YOU CAN DINE BY THE LIGHT OF LUMINOUS GRAPES



AN EFFECTIVE USE OF SHELL LAMP SHADES



THE SUNNY ISLES OF GREECE

AN EFFECT OF SUNSHINE THROUGH THE VINES, FROM CONCEALED ELECTRIC LAMPS

WHERE LUMINOUS FLOWERS CONTINUALLY BLOOM

electric lamps above each wing are the cause of this luminosity

An American residing in Paris, speaking of music at their restaurants, has said that "people who come here have too good a time to need to be waltzed through the soup, or polkaed through the entree." Not so with New Yorkers, however; the music provided is as sweet and entrancing as the atmosphere of this bowered garden. There are lights everywhere, but all are subdued, all of a different color, but soft and pleasing. The effect is very restful, but there is plenty of light on the tables, no portables being necessary.

The illustrations show an exceedingly clever use of mirrors in the production of vistas, and the apparent enlargement of rooms. In one of the pictures the camera was set but a few feet directly in front of one of the mirrored walls, thus taking the photograph by reflection. Can you find this among the views shown?

The possibilities of the electric lamp in the way of producing fantastic, novel, and even weird effects in interiors are almost limitless; and we may expect to see a much greater use made of them in the future.


# Simplicity as an Element of Decorative Art

By E. L. Elliott.

We have several times before preached from a text taken from Emerson, to wit: "We ascribe beauty to that which has no superfluous parts, which exactly fulfills its purpose." Believing also that example is better than precept, it is our present purpose to attempt a further exposition of this doctrine by the study of a few examples

Bad art might be divided into two categories: that which is ugly, and that which is tawdry. The first arises from the extreme of simplicity—a simplicity that leaves the object in physical and mechanical nakedness. Such for example, is a gas fixture made of common iron gas pipe put together with ordinary pipe fittings, or an electric drop light consisting of a socket hanging by a flexible wire. Tawdriness on the other hand, most often arises from an indiscriminate use of inharmonious or superfluous ornamentation. Tawdriness is not necessarily synonymous with cheapness, but is invariably the result of overdoing the thing. Conversely, good art is by no means confined to expensive production. As an illustration of this latter fact, examine the table lamp shown in Fig 1. It is difficult to conceive of a more simple construction outside of the naked mechanical essentials; yet there is harmony and grace in the few curved lines of the standard and shade which produces a distinct feeling of beauty. Every part can give a satisfactory reason for its existence.

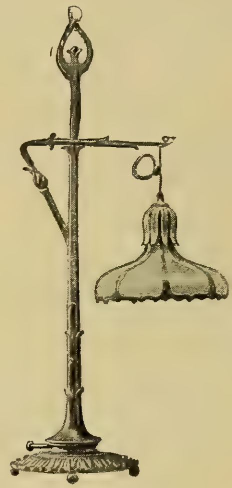


FIG. 2

FIG. I

Keeping our text still in view, let us next examine Figure 2. There is first a base of sufficient size and weight to give the necessary stability. The central standard is of sufficient strength to support the lamp and shade without being clumsy, while the loop at the top suggests a convenient means of carrying the lamp. As

a matter of actual mechanics, the lamp would stand just as firmly without a brace to the supporting arm opposite the shade; but this fact is the result of a critical study of the mechanism, which the mind does not readily make. This brace instantly appeals to the eye, and satisfies the instinctive query as to stability. Without this simple little device the involuntary thought would immediately arise that the lamp must tip over from the weight of the shade. The loop in the supporting cord, enabling the height of the lamp and shade to be varied is a complete justification for the general plan of construction. Note further the simple grace of all the lines.

FIG. 3

FIG. 4

The comments made concerning Fig. 1 would apply equally well to the bracket shown in Fig. 3. Both examples literally fulfill the tenets of our text. Applying the principle to Fig. 4, however, we find one manifestly superfluous part, namely, the metal saucer or disc immediately under the lamp socket. Which of the two is the more artistic? Compare in the same manner the brackets shown in Figs. 5 and 6.

Figs. 7 and 8 afford a similar comparison, Fig. 7 being perfectly simple, while 8 has the superfluous plaques under the sockets, and the vertical piece between the lamps.

FIG. 5

FIG. 6

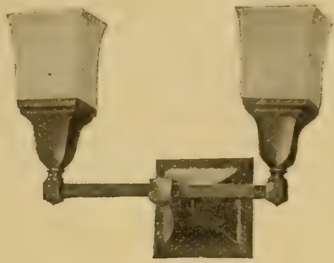


FIG. 7

Fig. 9 shows an apparent violation of the principles of our text. The construction of the supporting arm, with its two points of attachment, and the general lines are thoroughly good; but the effect is marred by a pyramidal boss on the wall-plate. This projection has no visible reason for its existence, and suggests that a part intended for some other construction has been purloined. The suspicion is confirmed by reference to Fig. 10, which shows a legitimate, and therefore artistic use of the same piece. The fixture manufacturer himself, and also the electrical contractor, will be able to give a sufficient reason for this construction, however. In many cases the outlet box is left projecting; or there may even be a capped gas pipe to reckon with. In order to make the fixture adaptable to all conditions therefore, the wall plate is made with the boss as shown. The presence of the "candle-fraus" on the electric brackets is simply a concession to custom and the demands of trade.

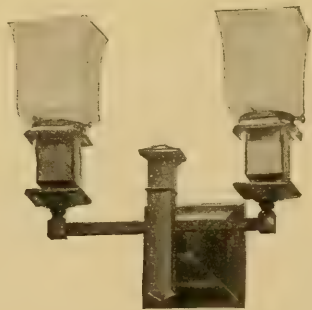


FIG. 8

Fig. 11 is an exceedingly fine example of the beauty of single curves. Compare it with Fig. 3, and note how much the varying diameter of the supporting arm enhances its appearance. This slight curvature, however, necessitates a casting in place of the plain bent tube used in Fig. 3, which of necessity adds much to the cost of construction; which shows that apparently slight modifications in design may influence the cost to a degree beyond what might at first seem reasonable to those unfamiliar with manufacturing details.


FIG. 11

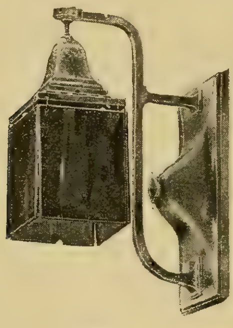


FIG. 9

Fig. 12 is well worth studying as an example of harmony of line with general simplicity of design.

Fig. 13 embodies the principles of simplicity combined with grace which are so essential in decorative art. While the fixture as shown was intended to receive an electric lamp, the ordinary upright mantle gas burner could be used with it equally well; in fact, would carry out even better the idea of the lamp which is represented. This is simply a single instance showing how easily the gas burner can be adapted to artistic treatment.

Finally, the contour of the glassware in each of the examples shown should be carefully noted. In every case the curves are essential to the unity of the design. Replace these with some other shape, and the whole effect is lost; instead of being beautiful in its simplicity, the thing becomes tawdry in its incongruity.

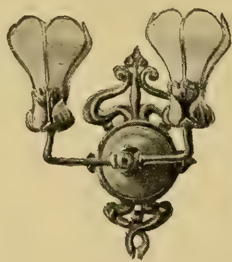


FIG. 12


FIG. 15


FIG. 10


FIG. 14

PORTABLES USED FOR SHOW CASE ILLUMINATION

## A Good Combination of the Useful and the Beautiful

Table lamps for use with either gas or electric light are a practical necessity in a great many cases in order to obtain a thorough good reading light. Furthermore, they lend themselves particularly well to decorative treatment, and many of the lamps shown are exquisite objects of art in themselves. There is perhaps no apparatus in the whole list of lighting fixtures which can so easily be made to serve the double purpose of utility and beauty. Doubtless more portables would be used if they were more commonly displayed in the stores that are most frequented. While many department stores carry a line of such lamps, they are usually huddled together in their proper "department," where they lose much, if not all, of their individuality, and fail entirely to display their useful purpose.

A method of solving the problem of displaying portable lamps to their best advantage, while at the same time using them for actual illumination, is shown in the illustration. The photograph was taken in one of the finest department stores in Cincinnati. The portable electric lamps are used to illuminate the goods in the show-case, and to add to the decorative appearance of the store. Their effect in the latter respect is eminently satistory, as the picture shows. There are stores which need special illumination, and no more effective way could be devised of producing this than by the use of portables in the manner shown; at the same time tags of some artistic design could be attached to the lamp indicating that they could be purchased, or duplicates of them, at stated figures. It would doubtless pay many stores which now do not handle them to put in a line for this purpose. Jewelry stores are especially adapted to this purpose. The plan is well worth trying.

A BUSINESS-GETTING SHOW WINDOW

A merchant's show window is the one salesman who regularly works overtime. In fact, it does its best work when all the other salesmen are off duty. The window display is undoubtedly most effective at night, provided, of course, that the illumination is such as to make it stand out as a distinct picture.

Portable lamps afford a peculiarly attractive means of producing a fascinating window exhibit, from the fact that they are luminous objects themselves, and show all their varied and striking artistic qualities to their very best advantage under these conditions. Such a display as that shown in the illustration would surely attract the passer-by, and might well be used as a sort of decoy to secure attention to less conspicuous goods which could be shown along with the lamps.

The portable lamp combines utility with decorative effect, or at least can be made to do so, to a greater extent than any other lighting fixture; for after all has been said and done, there is no light for reading and writing equal to that from the table lamp. And what is a prettier object than an artistically designed lamp, with the exquisite beauty of color, which can be produced only by translucency, of its illuminated shade? Truly, there is no place that a suitable portable lamp may not both grace and adorn.

# Theory and Technology

## A New Glass Reflector

By L. R. Hopton.

Up to within about ten years ago there had been practically no attention given to the utilitarian side of glassware used in connection with artificial lighting. Early scientists, it is true, had worked out mathematically the fundamental problems in connection with utilizing the properties of lenses and prisms in connection with lighting globes and shades, but their labors had resulted in no substantial results. The development of the art of pressing glass, which has been brought to a very high state in America, has made it possible to utilize the optical properties of glass in the construction of accessories for general illumination, and within the past few years globes and reflectors based upon this principle have been brought to a high degree of perfection, and have come largely into use. Notwithstanding the manifest merits of prismatic glass for this purpose, however, it is no unwarranted disparagement to say that it lacks some of the qualities which seem to the writer to be of essential importance in a considerable number of cases. It would indeed be a rare, if not wholly exceptional case, if every excellence were found combined in this single article.

Good illumination, according to the opinion of architects and decorators generally, a considerable proportion of laymen, and, apparently, the majority of illuminating engineers, rests upon considerations of art almost as much as upon those of science. In a recent paper before The Illuminating Engineering Society, Mr. Bassett Jones, Jr., summed up the matter by the statement that "no lighting installation, however efficient it might be in operation, could be called a success that in any way offended the artistic sense;" and from this dictum there seemed to be no dissent. From the artistic view point, prismatic glass, to say the least, has its limitations. From the optical standpoint, furthermore, such glass falls short of perfection. While prismatic globes appear luminous over their entire surface, the luminosity results from a collection of bright spots or surfaces of measurable extent, the intrinsic brilliancy of which is often sufficiently high to cause more or less serious glare. In prismatic reflectors this effect is even greater, especially when used in connection with high efficiency lamps. As compared with opal glass, which realizes theoretically perfect diffusion, prismatic glass leaves much to be desired. Attempts have recently been made to overcome this defect by thinly enameling glass, either on the inner or outer surface, or by roughening it with a sand blast or etching acid; but a moment's consideration of the optical principles involved will show that any such process must seriously interfere with the optical results sought. Again, the difficulty of cleaning glassware having an uneven or roughened surface, and the reduction in efficiency when the surface becomes soiled, is a defect that has not yet been overcome.

It was with a view of avoiding these defects, and at the same time retaining to as great an extent as possible the efficiency in lighting results, that the writer, some

time ago, began to investigate the subject of glass as applied to lighting accessories.

The several elements going to make up the perfect reflector or globe may be thus stated: efficiency in resulting illumination; artistic appearance; mechanical stability; ease of cleaning and minimum liability to become soiled; reasonable limits of cost.

FIG. I

Efficiency of illuminating results practically depends upon a redistribution of the rays from the light-source. For this purpose reflection is undoubtedly the better means. Regular reflection, though the most highly efficient, is out of the question where general illumination is required, for various reasons which need not be enumerated here, chief among which is the practical doubling of the glare of the original source. Diffuse, or irregular reflection, then remains as the one available means; in other words, the reflector with a diffusing surface, affords the best means of securing efficiency in light distribution for general illumination. For this purpose dense white opal glass, sand blasted on the reflecting surface, undoubtedly takes the lead; but it has three objections which counterbalance its high reflecting power, namely: the very rapid decrease in reflecting power, by accumulation of soil and dust, opacity, (a reflector for general illumination must transmit a sufficient amount of light to prevent deep shadows above,) and a hopelessly inartistic appearance.

Considering all these requisites, opalescent glass, and other means of deadening the surface than sand blasting or ordinary acid etching, were decided upon as the most promising line for experiments. After a considerable number of trials the glass manufacturer succeeded in producing a glass which is perceptibly translucent, but with a diffusing surface on the reflecting side. A new method was devised to produce this surface and it is entirely different from that produced by the ordinary etching, sand-blasting or enameling. While the "glaze" of the glass has been entirely removed, the surface is of such high degree of smoothness that it can be cleaned as readily as that of ordinary glass, and at the same time it does not give sufficient direct reflection to produce perceptible glare. The reflected light from this glass is of a pearly luster, slightly opalescent. The transmitted light shows variations of color running from pale orange to deep sienna. Its general effect is not unlike a polished sea-shell.

It is, of course, impossible to obtain as great a variety of distribution curves with diffuse reflection as with regular reflection. The study of a considerable number of actual problems in illumination, however, convinced the writer that, in the great majority of cases, where the illumination is produced from a number of sources, a distribution curve in which the principal part of the light is included within the angle from the vertical to 60 or 65 degrees fulfills the theoretical conditions within all reasonable limits of accuracy. Except for special lighting, such as desks, tables, etc., the concentrating reflector is theoretically and practically undesirable.

A reflector of this new glass, of the shape indicated in the illustration, Fig. I., gives a distribution curve as shown in Fig. II., which, in a majority of cases, is all that could be desired for general illumination.

The absolute efficiency of the reflector

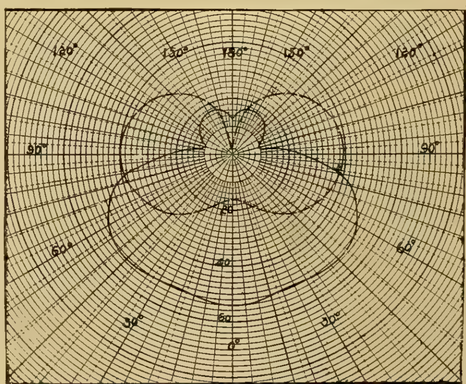


FIG. 2

determined by the Rosseau method is 92.29 per cent of the total spherical candle-power, 41 per cent. is distributed in the zone from the vertical to 60 degrees; 58.6 per cent. from 60 degrees to the horizontal; and 22.3 per cent. in the upper hemisphere.

As is well known, the curve resulting from a perfectly diffusing surface would be independent of the contour of the surface; and the more the reflection partakes of the regular, or specular nature, and the less of the diffusing nature, the more the distribution curve is influenced by the shape of the reflecting surface. Since in this glass the reflection is largely diffuse, the contour or general shape of the reflector may be varied to several forms without materially changing the distribution curve and being made by pressing, they have ample mechanical strength. As reflection is entirely from the inner, or first surface, dust settling upon the outer surface has practically no effect upon efficiency, while the both surfaces are as easily cleaned as those of ordinary blown glass.

# The 25 Watt and 250 Watt Tungsten Lamps

By W. J. Cady.

In the 25 watt and 250 watt tungsten lamps we have the two extremes in the latest developments in the tungsten lamps. Each has its own particular field of usefulness, but undoubtedly the smaller lamp will far outshine the other, when it comes to a question of usefulness.

The 250 watt, 200 candle power, tungsten lamp will be used largely for store lighting and will be used as a big stick in driving out the gas arc. To be effective it must be used with a proper reflector for two reasons :—first, the illuminating efficiency is greatly increased. Due to the form of filament in the tungsten lamp, the end on candle power of this lamp is very low, being only ten or twelve per cent. of the horizontal candle power as compared to 40 per cent. for the carbon filament lamp; and therefore the necessity for the reflector is very much greater in the case of the tungsten lamp than exists for the old lamp. The second reason why a reflector is necessary is that the intrinsic brilliancy of the tungsten being 2 and 3 times that of the carbon lamp, must have a reflector or enclosing globe to cut down the glare of the lamp. Whenever the unit is to come within the direct line of vision, a lamp with a frosted tip should be used, so that when used with a reflector the view of the bare filament is entirely done away with.

The tungsten unit has a number of very material advantages over the gas arc; first in the matter of appearance it is almost an injustice to the tungsten unit to compare it to the gas arc for the beauty in the ordinary gas arc is a negative quality; secondly, the white color of the tungsten lamp is distinctly better than the greenish-yellow color of the gas arc; thirdly, the fact that the tungsten does not heat up the room to anywhere near the extent nor vitiate the atmosphere as does the gas arc, is a very strong point in favor of the electric unit.

The stronghold of the gas arc has been in its cheapness of operation, but with the advent of the tungsten lamp, electricity is attacking the gas industry on its own ground. The relative cost of operation of the gas arc and the tungsten unit for equal illumination is 2 cents for the gas as against 3 1-3 cents for the electrical unit. These figures, however, are for new lamps and mantles, and when the fact is taken into consideration that the decrease in candle power for the tungsten lamp is from 5 per cent. to 15 per cent. in 1000 hours, whereas the gas arc decreases 40 to 50 per cent. in from 400 to 500 hours, it is seen that the tungsten unit can be run at as low an operating cost as the gas arc.

The real difficulty with the 250 watt tungsten lamp lies in the question of producing a satisfactory vacuum in such a large lamp. It is a question whether the lamp manufacturers can make this lamp with as good a vacuum as the smaller tungsten lamps have, and therefore whether the life of this lamp will be as great as that of the present smaller lamps.

The field of the 25 watt tungsten lamp should be almost unlimited as soon as the improvements have been made in the strength of tungsten filaments, improvements which are bound to come sooner or later. They already have in Europe the 220 volt 44 candle power tungsten lamp, a very difficult lamp to make, at best; but if this is already possible, improvements in the durability of the tungsten filament are assured. Europe has gone still further, and is now furnishing us with a 25 watt 20 candle power tungsten lamp which is claimed to have an average life of over 1000 hours and can be burned in any position. This last valuable property of the lamp is procured by having the filament mounted in the form of a helix and by having a number of supporting points. Originally the lamp manufacturers in this country recommended the burning of their tungsten lamps in a pendant position only, but already certain of these companies state that their lamps may be burned at any angle, which further goes to show how rapid has been the development of tungsten lamps.

The 25 watt lamp will come to be used in the homes and in many places where the 16 c. p. carbon lamp is now used, which includes a large percentage of all present lighting installations. People do not usually care to have 32 c. p. lamps in general use in their homes, but on the other hand would welcome a 20 c. p. lamp in place of a 16, particularly at a 50 per cent. reduction in the power consumed per lamp. It has been pointed out recently that the 16 c. p. as the standard unit of electric lighting was simply borrowed from the old 16 c. p. gas standard and that whereas the gas people had gone toward a much higher standard unit in the mantle burner, the electrical industry still held to the old standard. The fact that in the gas industry the tendency is toward a higher candle power unit is no reason in itself why the electrical industry must follow its example. It is well that the small unit has continued to be the standard, because there are a great many places where high candle power lamps with the ordinary methods of installations would be injurious to the individuals compelled to face such lamps. The home is an example of such a case, where ordinarily the light proceeds from lamps placed on central chandeliers so that if one is sitting anywhere in the room, except immediately below the chandelier, the light is very apt to shine in ones eyes. This does not mean that the present fixtures used in the homes are to be upheld, but that with conditions as they are, it is better to use a number of low candle power lamps upon the chandelier than to use one high candle power lamp on such a low fixture.

Central stations furnishing current on a flat rate basis will welcome the 25 watt tungsten lamp with open arms, for it will enable them to substitute this lamp for the old carbon 16 with an increase in light to the customer and a material saving in power to the central station. For the central station not furnishing current on this basis, the tungsten lamp may at first slightly decrease the business, but the adoption of a new lamp is a slow process and by the time the 25 watt tungsten lamp has come into general use, the increase in the business will more than make up for the decrease in power taken per lamp. Some people will use the new lamp to cut down in their lighting bill; a great many will continue to use almost as much current but will increase the illumination of their home or store. Then there are those who are now using gas who will be very glad to adopt electricity when the cost will be cut down to nearly 1-3 of what it now is. It is from these that the central station will have to look for its future increase in business in the lighting field.

# Light versus Dark Symbols in Printing

By A. J. Marshall.

In my article, "Light Versus Dark Symbols in Printing," in "The Illuminating Engineer, January, 1908," I endeavored to bring out the purely physiological side of this subject in a practical manner. I thought that I had stated my theories simply and clearly, but it seems that such was not the case. I am led to believe

that same was not understood, owing to the fact that some who have criticised this theory have almost entirely lost sight of the varous points which I endeavored to bring out.

Briefly stated, such points were as follows: It is a well known fact that black surfaces absorb, and white surfaces will reflect the light thrown upon them. Therefore, black is a non-stimulant, while white does stimulate the retina of the eye. Generally speaking, printed matter is printed with black symbols on white backgrounds. With this method it is reasonable to state that one does not actually "see" what is looked at, but what is seen is the surrounding white background, and the letters, or symbols, purely by contrast. In this manner the eye is compelled to receive the light rays which are reflected from the white background, which generally is infinitely larger than the area taken up by the symbols.

The remedy or method which I suggest is the use of light tinted symbols on a dark background. With the use of this method the light tinted symbols would reflect the larger percentage of the light rays striking their surfaces, while the dark tinted background would absorb nearly all of the light rays striking same, thus performing the function for which the background was devised. By the use of this method the eye will naturally "see" directly and not indirectly as with the method now in use.

In the July, 1908, issue of "The Illuminatng Engineer," Dr. Nelson M. Black takes issue with the writer on the practibility, from a physiological point of view, of making use of the theory presented, and among the criticisms he makes use of the following general statements:—

First: "Dark characters upon a light background have been used from time beyond recall, and the human eye has been adapted to this condition."

The mere fact that we have followed some method of procedure from time immemorial, to my mind, is no reason why we should continue to so act, especially when we have cause to feel that such method is contrary to what seems to be desirable. To undertake to change from the present day method of printing over night, without the necessary due course of evolution would be foolish, to say the least. I realize fully the force of habit, and that it cannot be overcome in a short period of time.

The test of printing one page with black letters on a white background, and on the opposite page to use white letters on a dark background, and asking the public, who have been accustomed to using the former method for untold years, until the eye has naturally been forced to adjust itself to that condition, to judge the value of the two methods, and allowing their opinion in any way to settle research and discussion on the subject, seems to me unreasonable.

Second: Irradiation from white characters upon a black background is marked, making the characters, it is true, appear larger, but less sharply outlined."

The fact that the characters are less sharply outlined in the printing referred to was largely due to the poor sample of the proposed method. I have in my possession some work wherein the white letters on black backgrounds are sharply cut, and very distinct, so that, so far as this general criticism is concerned, we find it is largely a matter of the printer's ability.

Third: "Luminous points or small brightly illuminated areas tire the eye much more than dark areas surrounded by brighter ones."

I am at a loss to understand how this criticism can be applied to the theory presented, inasmuch as the actual intrinsic brilliancy of a light tinted letter on a dark background is no greater than that of a white background, which is ordinarily used and on which is printed black symbols. In fact, there is every reason to believe that the intrinsic brilliancy would be actually less. The area, or size, as well as the intrinsic brilliancy of a surface must be taken into consideration, and I feel that it is reasonably safe to assume that there will be actually less eye strain with the small area occupied by the light tinted symbols than by the much larger area given for a white background.

Fourth: "There is always the production of disagreeable after-images which are confusing."

This criticism apparently has direct bearing on the Doctor's first statement, inasmuch as these so-called after-images would hardly exist if the eye were accustomed to the proposed method.

With reference to the Doctor's remarks on the use of light or white lettering on display signs, which he says is simply done to attract attention, and that the sign is read while the eyes are directed elsewhere: If the light or white symbols can be read without the eyes looking at them, then I think that this method should be adopted by all means. The mere fact that the light letters on these signs do attract attention is the best evidence of their value, and I would not be very much surprised to find that the Doctor had a similar sign (black background on which were letters in gold,) placed outside of his office.

The writer expects in the near future to conduct a series of experiments in order to determine the most satisfactory combination of tints or colors in printing, as well as to determine the quantity of light rays reflected from various treated surfaces on which is contained printing in its several forms.

# Recent Progress in The Voltair Arc

By Isidor Ladoff.

Numerous European and American inventors proposed the use of all imaginable chemical substances and their combinations for the indicated purpose. Mr. Weston, for instance, in America, took out a patent (No. 210,380) for making a carbon having the form of a tube, the hollow part of which was filled with materials or substances that were claimed to produce a quieting effect on the arc. On July 5, 1879, Louis Siemens took out a German patent (No. 8,253) wherein he claims a solution of a substance in which the carbon is suspended. This solution is then forced under pressure into the hollow tube. The carbon is then dried. With this patent, later on, Siemens brought suit for infringement against all German carbon manufacturers making a cored carbon, and his patent was granted, not on the claims of the invention of the core, but on the process of forcing the coring mixture into the carbon by using pressure. In England, however, Siemens' patent was canceled or rejected on account of the patents of Jablochkoff (German patent No. 663) and Weston (1878, U. S. patent No. 210,380). The particulars may be found in a publication by Hippolite Fontaine, 1878-1879. Bremer exhibited a lamp with mineralized carbons at the Exposition of 1900 and attracted general attention to this subject. However, he has been stopped by the formation of slags and could not obtain good results with the ordinary disposition of the carbons, as he stated himself (Electrotechnische Zeitschrift, April 4, 1901, page 304) and as stated in the report of the International Society of Electricians (1901, page 364, France) on the authority of the Central Laboratory of Electricity. Bremer was forced, accordingly, to prefer a new type of lamp, in which the two carbons are placed obliquely, converging towards their lower ends, which occasions many inconveniences. This disposition of the carbons has been copied by numerous lamp designers, who adopted for the carbons a coring system. None of these systems were satisfactory. The entirely mineralized carbons produced excessive slagging. Carbons with strongly mineralized cores operate acceptably only with an excessively high current that causes a too rapid burning, short life. Furthermore, up to this time one could not use lamps of low current intensity with strongly mineralized carbons, one could not render practical a current consumption inferior to six or seven amperes, and in reality, the German lamps work under the intensity of nine amperes and above. It is true one can thus obtain an increase of light, but with a sacrifice in economy.

By introduction into carbon electrodes of substances having a high light radiating power (electrolytes) such as salts of the calcium group of elements, the carbon arc itself is rendered highly luminous and becomes the principal source of light, in-

stead of the heated end of the positive carbon (crater), as in the case of the ordinary arc lamp. The hot gases generated by volatilization of the salts in the carbon furnish a path of less resistance than the air for the passage of the current and this permits the electrodes being drawn much further apart (higher drop of voltage across the arc), producing an arc of 1½ inches to 2½ inches long. The light thus produced is, with the calcium salts, of a golden tint, hardly distinguishable from the color of the light of an ordinary flame and incandescent electric lamps. This yellow color of light is for the purpose of exterior illumination, a point decidedly in its favor.

In efficiency as light producer, the luminous arc is revolutionary.

The effect of addition to the carbon electrodes of volatile salts consists in the lengthening of the arc, following a corresponding drop of potential, not only at the terminals, but in the gases composing the arc, whose conductivity is increased. According to L. F. Tufts (Phys. Review, C. XXII, 4 p. 273), the luminosity of a flame varies in the same sense as the conductivity of the gases composing it. According to F. S. Nutting (Bull. of Board of Standards, VI, 1), salts introduced into the arc seem to reduce its temperature (Ranner, for instance, found a difference of 170 degrees C. between the temperature of an arc between cored and solid pencils). The same authority claims that the relative intensities of two primary spectra of a mixture of gases depend on the relative atomic weight of the compound gases Other things being equal, the spectrum of a mixture of gases, the spectrum of the gases of greater atomic weight will be higher.

*Oxidic or Electrolytic Arc Light Pencils.*

Rasch (E. T. Z. 22, page 155, 1901) used metallic oxides as material for arc light pencils, namely, magnesia, lime, oxide of aluminum, oxide of zinc. He is of the opinion that an arc produced by such electrodes give a very high efficiency. The electrodes gives a very high efficiency. The conductors of the second class, which, as known, do not conduct when cold. With increasing temperature their resistance drops. It is impossible to form an arc between them if they are not preliminarily heated so that a current could pass through them. Rasch proposed to use auxiliary electrodes out of carbon or other suitable material for the purpose of preheating these oxidic electrodes. (As known, Jablochkoff and Nernst anticipated him in this device). The temperature of the tips of the pencils when the arc is drawn between them is very high corresponding to the high melting point or vaporization point. He also mentions metallic silicides and borides.

The spectrum of the electric pencils contains few ultra violet rays, but chiefly light-producing yellow and green rays. An arc drawn between pencils made of magnesia or zirconium is claimed to be similar in tone to the sunlight. By the choice of the material for the electrodes the color of the arc may be influenced; as known, an arc between electrodes containing oxides of nickel or of chromium appear yellowish in comparison with the color of the carbon arc. Rasch distinguishes between electrolytic electrodes with a very high cold resistance and calls them hard electrodes, and electrodes with moderate conductivity in a cold condition, and calls the latter soft electrodes.

An arc between soft electrodes is highly unsteady, just as between metallic electrodes. When the current was kept constant, Rasch could not notice an increase in the length of the arc with the increase of the voltage, probably on account of the melting of the tips of the electrodes, in consequence of which it was probably impossible to make any accurate electric measurements. When hard electrodes were used, Rasch could distinguish a relation between the strength of the current, the voltage and the length of the arc. According to Thompson's formula—E = bL

—— in which a was equal to 31.35 volts. Nernst, however, found in his experiments with soft electrodes a larger consumption of the material of the pencil in the arc, and what is especially remarkable, he found that consumption of the negative electrodes was considerably higher than of the positive electrode, while the opposite of it is true concerning carbon electrodes. The consumption in the hard electrodes used by Rasch is not so high.

Among all metals titanium furnishes the best material for arc light electrodes. Next to iron it possesses the richest spec-

trum as far as the number of lines is concerned. Titanium excels all non-rare metals in the nature and extent of the light-giving part of the spectrum. Thalen counted 201 lines in the red part of the spectrum out of 6,556, about 4,163 in violet. Liveying and Dewar counted between the same four new ones, and Corner twenty-five in the ultra violet, together 230 lines. In the red part are only two, in the orange 17, in the yellow 32, in the green 70, in the blue 35, in the indigo 45, in the violet 4 lines. One hundred and eighteen are Frauenhoffer lines recognized in the atmosphere of the sun. Thirty-two of these are artificially restored by Liveying and Dewar to their actual state. Being a comparatively poor conductor of electricity, titanium can be used advantageously as material for arc light pencils only in its combination with a metal having a comparatively high electric conductivity, as iron, copper, etc.

Our examination has included all the U. S. and foreign patents classified in the Patent Office as relating to the subject of the use of Titanium for arc lighting purposes; a large number of files, and leading publications, etc., as found in the Patent Office Scientific Library, among which may be mentioned the Reportorium der Technischen Journal-Literatur, Berlin, formerly Leipzig (and now issued by the German Patent Office) from 1823 to 1904, inclusive; the card indexes relating to arc lighting as found in the said library, and other similar sources of information. Wherever a reference was made to such an article as "Twenty-five Years' Progress in Arc Lighting," *Electrical Review*, N. Y., 1897, Vol. 41, page 654; "Fifteen Years' Progress in Arc Lighting," Elihu Thomson, *Electrical Engineer*, N. Y., 1897, Vol. 23, page 11; "Recent Progress in Arc Lighting," Elihu Thomson, *Electrical Review*, 1897, Vol. 30, page 292; or "Arc Lighting in America and Europe," C. Wiler, *Western Electrician*, Chicago, 1897, Vol. 20, page 256, it was examined.

Other works, such as certain volumes of Watts' Dictionary of Chemistry, London; Treatise on Chemistry, Roscoe & Schorlemmer, N. Y.; Journal of the Society of Chemical Industry, London, and Annales de Chimie et de Physique, Paris, were also consulted. In Vol. 25 of the series of 1892 of the latter work. beginning at page 433, is a lengthy article, almost a volume in itself, by Levy, entitled "Contribution to the Study of Titanium." The subject is discussed under a variety of heads, none of which refer to the use of the metal in electric lighting.

Examination has also been made of several articles found otherwise referred to in the well known work entitled "Comptes Rendus," etc., Paris, but without results.

But few allusions to titanium or any of its compounds as, in any way or to any extent, would be valuable for use in an arc light pencil, have been found except the patents above referred to.

In reviewing the literature of the patents just mentioned, we will notice that the use of the titanic and ferric materials for electric lighting in general and arc lighting in particular, was known a long time ago. Patrick Mackay, in his Letters Patent No. 325,257, dated Sept. 1, 1885, claims as material for manufacturing electrodes for electric lights, a mixture of the oxide of titanium in powder and a hydrocarbon oil. The oil will, of course, disappear in the process of manufacture of the pencil, and the pencil will be practically composed exclusively of the oxide of titanium. He expressly claims all the known forms of natural titanic acid, namely, anatase, octahedrite, rutile and brookite. Further, he states that he is aware that titanium was proposed for use for lighting purposes in the form of beads, rods and strips in incandescent lamps and disclaims the broad use of conductors from the metal titanium or from the oxide of that metal by itself.

The next to mention titanium as a source of electric light was Thomas A. Edison, in 1878, Oct. 23, in his British patent No. 4,226.

Louis L. Jones, in his Letters Patent No. 484,553, dated Oct. 18, 1892, claims a mixture of non-conducting refractory oxide with a metallic or conductive oxide. This will obviously include a mixture of ferric, ferrous and titanic oxides.

Haefener and Langhans, in their German patent, issued July 17, 1888, No. 44,183, claim a filament for incandescent lamps composed partly of oxide of titanium.

*(Continued in next issue.)*


## Is Supplying Electricity a Natural Monopoly?

Of all the bugaboos paraded by demagogues and theorists to frighten the innocent public, the word "monopoly" stands at the head. Even admitting for the sake of argument that almost all monopolists are devils, they may not be as black as they are painted. It has perhaps never occurred to many, that the reputation which America has justly earned of surpassing all nations in inventive genius, as well as the phenomenal development of our manufacturing enterprises is to a very large extent the result of monopoly guaranteed by the government, familiarly known as patent right. To every one, native or foreign born, who has discovered "a new and useful" idea of any kind, our government will guarantee an absolute monopoly in the use of that idea for a period of seventeen years.

The carrying of the mails is an enormous business which is absolutely monopolized by the government, from which it is reasonable to infer that there are some things at least, which may be justly called "natural monopolies." Such monopoly may be coextensive wth the entire country, or it may be only of local application. The telephone offers another example; there is no doubt that a single telephone system giving good service at fair rates is more satisfactory than two or more competing systems.

A recent decision by the newly created Public Utilities Commission of New York State in refusing to authorize the establishment of a competing electricity supply concern, or Central Station, in New York City, brings up the question whether or not the public supply of electric current is a natural monopoly. For a number of years a single company has controlled the entire supply of New York City. Recently another company, having powerful financial interests back of it, wished to enter the field; but before being able to proceed it was necessary to obtain the consent of the Commission to issue its stocks and bonds. After a full investigation and hearing upon the matter, the Commission decided that a competing company was not needed. Although some technical objections were cited in the opinon, the real reason for the decision was the fact that the company was not needed. Against the argument that competition would bring down the price of current and insure better servce, the Commission answered that it had ample power in itself to reduce the present rate charged by the monopolistic company if assured if such reduction would not reduce the profits below a reasonable figure, and to make such regulations as would insure proper service. It also pointed out that there was no possible means of preventing the proposed competing company from sooner or later falling into the hands of the present company, and so ending the competition with the advantages claimed for it

Taking the purely business view of the matter, we believe that most people would agree that a single lighting company making fair and indiscriminating rates, and furnishing reasonable and proper service, would be on the whole more satisfactory than two or more competing companies, each striving to work out its own salvation—or destruction—with a free rein. The Commission calls attention to the very im-

portant fact that, even though the company seeking the franchise might be actually a competitor at the beginning, there was no power on earth that could prevent its final consolidation with the present company. The great engineer, Stevenson, uttered one of the most profound axioms in political economy ever enunciated when he said that, "where combination is possible, competition is impossible." Neither unrestrained competition, nor public ownership, nor public supervision, is ever going to enable the public to get something for nothing. Competition may temporarily reduce prices, even below the profit line, but in many cases reprisals taken. This is particularly apt to be the case with competition in public utilities. Greed is a natural and within certain limits, a necessary characteristic of human nature; and the corporation, like the individual, may be counted upon in the long run to secure every advantage for itself that it safely can. In the case of corporations dealing with public utilities, therefore, the necessity for some means of restraint is a necessity, if a fair balance between those served and those serving is to be maintained.

The question whether such restraint can be most effectually accomplished by the commercial warfare known as competition, or by means of government authority, local or otherwise, is one which can only be answered by actual experience. One thing is reasonably sure: unrestrained monopoly of public utilities is nearing its finish in this country. Competiton as a regulative force has been fairly well tried out, and it was perhaps a wise action on the part of the Commission to give government regulation a chance to show what it could do. If the commission will exercise its powers fairly, but vigorously, and if the corporations which enjoy monopoly by virtue of this Commission are sufficiently far seeing and broad minded not to overreach themselves, but show a genuine disposition to give as good service as possible consistent with reasonable profits on a capitalization that is not too palpably acqueous, there will be no serious public protest against their monopoly. But the whole outcome will depend upon the "if's." If the Commission becomes infected with politics, and allows its enormously powerful influence to become an article, a political barter, either unrestrained competition or some more drastic measure will be taken to safeguard the rights of the people.

## The Laborer is Worthy of His Hire

We have several times called attention to the opportunities which illuminating engineering offers to the electrical contractor as a means of enlargng his field and increasing his business. It seems that one particular contractor who ventured into this field has come to grief, and has confided his troubles to "Selling Electricity." The story is briefly as follows:

A certain large shoe store in this city had a lighting installation which, though probably as good as the average, nevertheless gave far less efficient results than could be obtained by the use of the latest lamps and accessories installed on an illuminating engineering basis. The contractor represented to the merchant that, by putting in a new equipment the cost of which he estimated at $525, he could insure a saving of $133 per month on electric current; and in order to show his faith by his works he went so far as to install a sample fixture at his own expense. The merchant was satisfied with the results, but found that he could purchase similar fixtures in the trade, and have them installed, for less than the estimate of the contractor; whereupon the contractor "went up in the air and staid there." "Selling Electricity" ascribes this aeronautic feat to the manager of the store on being presented with the contractor's estimate, but the context of the article plainly indicates that it was the contractor who made the ascension.)

The outcome of the whole affair was that the merchant had the installation put in himself, buying similar fixtures in the open market, and having his wiring done by presumably the lowest bidder, while the contractor pocketed his specifications, removed his sample fixture, and charged up his loss to his experience account; which moves "Selling Electricity" to ask with a sob, "Now what can you do in a case like that?"

A successful constructing illuminating engineer to whom we put the question answers laconically: "Business"; and explaining briefly says: "If you are going to

sell stock fixtures in connection with a wiring contract, sell them at a fair profit. If your engineering skill is of value, charge for it. Don't boost prices on your customer's ignorance; be honest." Thus much from an actual practitioner who has been successfully handling exactly such problems for the past three or four years.

The whole difficulty in this case arose from the fact that the contractor did not have sufficient confidence in the engineering part of the problem to come out squarely and make a charge for his engineering skill, but tried to secure his fee by adding it on to the price of the fixtures.

The scheme, being unbusinesslike, met exactly the fate that might be expected when it was put up to a keen business manager. In the first place it was a mistake for the contractor, while acting in the capacity of a consulting engineer, to furnish his specifications before he had a definite understanding as to his fee. What would be thought of an architect who would furnish preliminary plans and specifications without being first assured of compensation for his work? In the second place, the value of "knowing how" should have been given a fixed value in the final proposal. If necessary, a guarantee of results could have been easily made. Every item in the specifications would have then been clearly mentioned, and if the merchant found that he could purchase any of the items for less than the price mentioned in the specifications it would be his privilege to do so. The contractor was unquestionably in a position to make prices at least as low as the merchant could have been able to get from any other source.

The illuminating engineer is as worthy of his hire as any other engineer when acting in a consulting capacity, but if he gives away his knowledge first, and seeks to recover in some roundabout way afterward, he must not complain if he fails. If the illuminating engineer has not faith enough in the value of his professional knowledge and skill to demand a reasonable fee for it, no one is going to urge him to accept compensation for his services, especially after he has already presented them, wholly or in part. The doctor does not prescribe, nor the lawyer advise, without making it understood that his knowledge has a money value, which he expects to receive.

## Public Lighting and Health

One of our electrical contemporaries sees danger ahead,—in fact, believes that it is already here, from the indiscriminate use of the flaming arcs and other brilliant light sources in the streets, and suggests that the placing of such lights be supervised or regulated by the Board of Health. The contest for supremacy in the production of glaring light goes merrily on, and the end is by no means in sight. The actual danger, however, of injury to the eyes from the public use of the latest glare-producers seems very remote. The person who strolls on the "Great White Way" until his eyes are blinded by the glare of the lights can well be spared to recuperate in seclusion. Our contemporary has perhaps been misled by the peculiar blinking and turning of the eyeballs which we are credibly informed, are commonly seen along this famous thoroughfare, but which are not necessarily caused by retinal fatigue.

There are, however, cases in which the illumination should be passed upon by the guardians of the public health, chief among which are the public schools, and of scarcely secondary importance, the public libraries. In both of these classes of public buildings conditions are only too frequently found which may very readily work serious injury to the eye-sight of those using them, particularly children. It is unfortunate that bad lighting does not cry out for suppression like bad odors, or needless noises, if such were the case, illuminating engineers, electrical contractors and gas fitters, would be deluged with work beyond hope of extrication.

## Illuminating Engineering and Fixture Manufacture

No one connected with the lighting industries has received more scathing condemnation at the hands of illuminating gineering. That the fixture manufacturer Next to the architect, the "fixture man" has been blamed for the most serious sins committed against illuminating engineering. That the fixture manufactueer has been guilty as charged in the indictment has unquestionably been true to a

very large degree. It is probably true, however, that there have been more or less extenuating circumstances which have not been brought clearly to light, and which should have some influence in determining the responsibility. Without any intention of merely shifting the blame, the manufacturer does not hesitate to charge a considerable amount of the responsibility back to the architect. He contends that the general plan of lighting is left until the last minute, and the outlets often arranged before he is called upon to perform his part of the installation. It then often happens that he is expected to perform a miracle,—to create light by his mere fiat. This is simply a phase of the general neglect of the lighting proposineers have inveighed from the beginning of their existence.

The way out of the difficulty is not hard to find. The fixture manufacturer must become in fact what he is n theory, namely, a constructng illuminating engineer. There is no one at the present time in a position to render such immediate and valuable services to illumniating engineering as a profession as the fixture manufacturer. The architect has long besen accustomed to deal directly with him, and in the majority of cases has unconsciously looked upon him as an illuminating engineer He s therefore persona grata with the architectural profession, which can scarcely be averred of the independent illuminating engineer, and is therefore in a position to work in harmony with the architect and decorator Furthermore, the fixture manufacturer is entirely independent commercially, of any particular luminant, lighting device, or accessory, and threfore in a position to give strictly impartial consideration to all available ways and means of producing ilumination. An illuminating engineer should be as necessary and as important a member of the personae of a fixture factory as the designer or superintendent The first work in any installation should then be done. The order of procedure in the illumination of a building would then be as follows:—As soon as the plans were advanced to the stage where the size of the rooms, height of ceilings, and the purposes for which they are severally intended to be used have been determined by the architect, these conditions, together with specifications as to the ornamental treatment,—such for example, as the type of architecture, and perhaps a maximum cost—would be sent to such fixture manufacturers as it was desired to have submit proposals. The architect's specifications would then go to the engineering department of the fixture manufacturer, where the intensity of llumination required in the different rooms would be specified, and the outlets and number of fixtures located. The original specifications, with the further specifications of the illuminating engineer would then go to the designing department, where designs would be worked out which would fulfill the requirements of illumination, and accord with the general principles of harmony as embodied in the architect's requirements.

Of course, the order of procedure here set forth is not to be considered as an inflexible rule of practice During the progress of the work there would naturally be more or less occasion for conference and co-operation between all of the interested parties The important thing is the careful consideration of the general problem of illumination from the three different standpoints, namely: the architect, the illuminating engineer, and the fixture designer, in order that the final result may embody harmonious combination of the several essential elements of every illuminating engineering problem. It is only by such a general method of co-operation that the best results can be obtained. This being the case, it may be stated with certainty that such a procedure must in the end generally prevail Fixture manufacturers must sooner or later recognize that illuminating ngineering is the very foundation of their business. Those manufacturers who recognize it sooner must assuredly take the lead, while those who recognize it later must eventually fall in at the tail end of the procession.

## A Business without an Organization

Edward Everett Hale wrote a most interesting and instructive book depicting the trials and tribulations of "the man without a country." In these days of "community of interest" in nearly every line of commerce and manufacturers, a business without a trade organization of called a business without a country.

From the National Manufacturers' Association, which takes in every phase of the manufacturing industry, down to the barbers and dancing masters, there is scarcely a single division of our great commercial and industrial fabric that is not represented by some central organization, having for its purpose the common good of all those whose material progress and prosperity lie in the same general line. To this general rule there is one notable and startling exception: the makers and sellers of lighting fixtures are unorganized.

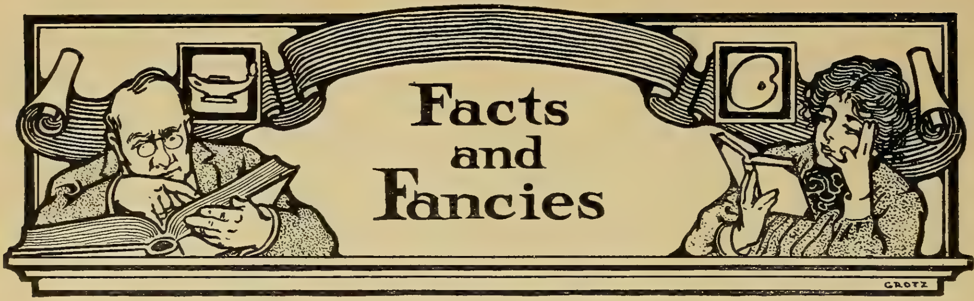
The business that is unorganized is disorganized; and to be disorganized is to waste valuable time, labor and money in useless duplication of effort and destructive, cross-purpose policies. When you hear a man charging his compeers in business with underhanded methods of securing trade, and of piratical and unscrupulous practices generally, you may put it down that the particular line of business he is in is without a central organization. Such is the condition of the fixture business to-day. Every manufacturer is afraid of every other, and considers him a commercial highwayman. Every new design must be kept in the utmost secrecy, lest some competitor steal it and pass it off as his own creation, or flood the market with cheap duplicates. We have repeatedly been refused permission to publish illustrations of special designs for this reason.

The manufacture and sale of lighting fixtures is essentially a high-class business, combining artistic taste, inventive ability, and mechanical skill. There is no reason why it should not be conducted upon as high an ethical plane as any other branch of industry. It is most reasonable to suppose that this industry has attracted to it only commercial pirates and shysters. The whole trouble lies in the fact that, as a business of national extent, it has no central organization. The fixture manufacturers and dealers should get together without delay and organize a National Fixture Association. There are any number of reasons why such an association would benefit manufacturer, dealer, architect, and user. If there are any reasons why there should not be such an association, we would be pleased to hear them.

While the competition is based upon principles which make for progress and the mutual benefit of buyer and seller, it nevertheless contains a destructive element. So long as it is rivalry, well and good; but when it begins to be warfare, it partakes of the nature of war, of which Gen. Sherman gave the true synonym. "All is fair in love and war" is considered good; but when it begins to be warfare, it then "strategy"; and destruction is the one element on which the final victory depends. Competition, left a free rein, is sure to run into warfare; the fixture business to-day is in this condition. The only hope of honorable peace lies in a better mutual understanding among the various parties interested, which can be brought about only by a national organization.

## Lighting Accessories

The term "fixture" is now generally used to specify the mechanical device or devices which are necessary to support the lamp and its accessories. Lamp has come to mean the special apparatus necessary to produce light from the luminant, while "accessory" is usually understood to include all the appurtenances used for distributing and diffusing the light after it has been generated. The selection of the proper accessory therefore constitutes no small part of functions of the illuminating engineer. Every improvement in the line of accessories is therefore of importance second only to improvements in the lamps themselves. The contribution from Mr. Hopton in another section of this issue, in which he describes a new form of glass reflector, will be read with interest. Mr. Hopton is one of the very few illuminating engineers who is associated with a fixture manufacturing concern; and the fact that he has started out by making an original and valuable contribution to the material progress of the profession is a most encouraging omen. Illuminating engineering and fixture manufacture are as logically connected as electrical engineering and the manufacture of generators and motors. The company with whom Mr. Hopton is associated is to be congratulated upon their substantial realization of this fact.




# Sam M'Gee's Illumination Economy

By Guido D. Janes.

When Sam McGee was mayor of the economical municipality of Quincy not long since, he decided to curtail the expense of illuminating the streets, so he sat up late one P. M., and thought up some scheme to save the taxpayer from excessive light bills.

Being a man with plenty of intellect, he soon came across a plan in his thought, stumbled against it as it were, while agitating the apex of his head with several fingers. After doing said stumbling he went to sleep.

Early next A. M., he arose from his place of snore, and after masticating several varieties of victuals, went to the city electrician and laid before him the scheme.

The said electrician was delighted with it. And without pausing to congratulate Sam, rigged up a switch, an automatic switch, one that would work if any individual would step upon it, a switch that would turn off and on an arc light with impunity.

Then having made the one, he duplicated same three times. After which he put on his hat and went onto the thoroughfares. There he found a good place to install his switches, and taking off his coat did so. The scheme as originated by Sam was this: to place the switches in such a location that when the inhabitants would approach an electric light on the highway they would step on the switch, and light said electric light. Then being lighted on their journey within the range of the illumination, the inhabitants would cut off the light by strolling over another switch placed on the other side of the arc. Similar switches to be installed in the streets for the vehicles, were also planned.

THE CITY ELECTRICIAN AT WORK

It was further arranged that no matter from what direction you approached the illumination, it would light the lamp, as the angle and position of the heel would automatically fix it in the desired manner. So it will be seen that the arc did not burn when there was no one in the locality to be benefited thereby.

The whole thing worked all right, and the illuminating bill of the municipality was reduced quite a good deal. Sam was placed on a pedestal of course, and not a few of the inhabitants mentioned his name for the vice presidency.

So when election day came around and he was out again for the office of mayor, he had enough campaign material to elect him several times over. In fact, by his illumination economy he had won enough votes to make his job unanimous.

J. R. LUTTERAL

But the night before the election his opponent, J. R. Lutterel, who was running on an independent ticket, thought of a plan to defeat Sam. Yes, he thought of a scheme to make Sam feel out of sorts and blue, and to cause him to sign his name Ex-Mayor McGee.

J. R., at one time trimmed arc lights, and could read a meter with impunity, therefore he was quite familiar with electricity. So after supper on the evening preceding the election, he procured a pair of pliers and a lot of copper wire. Then he visited as many of the economy switches as he could, and so exposed the wire of the said switches that when stepped upon, the current from the same, instead of wandering along proper channels would not do so; but wander in alien places. This being done, he hid behind a tree, and wrapped wire around his sides so same would not split when the big show would come off. Before J. R. had been in hiding five minutes Hank Fodder came along. He sauntered down the street in a leisurely manner whistling. But when he stepped onto the doctored switch he paused in his whistling and said "goodness" or words to that effect. Then, without a bit of warning he sauntered up into the atmosphere and landed out on the highway with a couple of thuds.

At first he lay there quite ill at ease and melancholy, and made no attempt to get out of the way of vehicles. But presently, after his range of vision was illuminated with "stars" enough for him to

see his location, he got up, and began to criticise Sam. Yes, he criticised him in a manner that if the election had been held at that moment he would have voted against said Sam.

Meanwhile Hank Fodder's experience was being duplicated all over the corporation. On Tryon street so many citizens were tossed into the street, that those who caught on exercised their sides in smiling at folks who accidentally meandered onto the doctored switches.

So when the following morning broke, Sam's constituency were out of sorts and bruised up. Yes, they were in such a condition and humor that when the polls were opened they criticised him there, and placed said criticism in the ballot box.

"Folks, voters and fellow citizens," cried Sam at the fourth ward about ten in the A. M., "vote for me. The switch was fixed by my opponent for campaign purposes. You got a shock not from me, but from him. Yet you will vote for him." Then he shed tears to show he was sincere in his remarks.

But the voters who were able to be out after being shocked the night before made a face at Sam, and when the polls were closed at five o'clock after dinner, Sam had lost the election.

"Gentlemen," said J. R., as he looked into the ballot box and saw himself there in a unanimous manner almost, "It pays to be economical. Sam started the economy. I will keep it up. Keep it up because it is cheaper to pay a $70 electric light bill each month, than $700 in damage suits per the same time."

"Hurrah for J. R.," cried the voters when Sam made this remark. After which they went home, for they were quite hungry and tired.

# A Magic Illusion Box

One of the most interesting and "sensational" tricks of the professional juggler is to make an object disappear as if it vanished into thin air, or to make an object appear in the place of another without any apparent motion. The method of doing this is simple enough when once explained, and some ingenious electrician has embodied the principle in what he calls "a magic illusion box," which can be made to afford an endless amount of amusement to both children and grown people, and can also be turned to very good account as an advertising novelty for store windows.

The principle upon which this device is constructed will be readily understood by reference to Figs. 1 and 2; Fig. 1 being a plan and Fig. 2 a prospective view. The apparatus consists of a square metal box having a glass window occupying about half of one of the sides (D, Fig. 1), and a sheet of glass partition (C) placed diagonally across inside. Two light sources (L and L) are placed on opposite sides of this partition, a half of which is covered with a sheet of metal to render it opaque. The method of operation is as follows:—

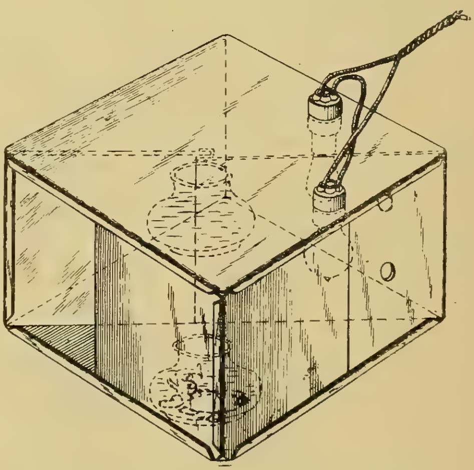


FIG. I

A and B are two objects similar in general appearance,—for example, two bird cages,—one empty and the other containing a bird. The observer, standing in front of the glass window D, and looking into the box, will see the empty cage A straight in front of him if the lamp L is

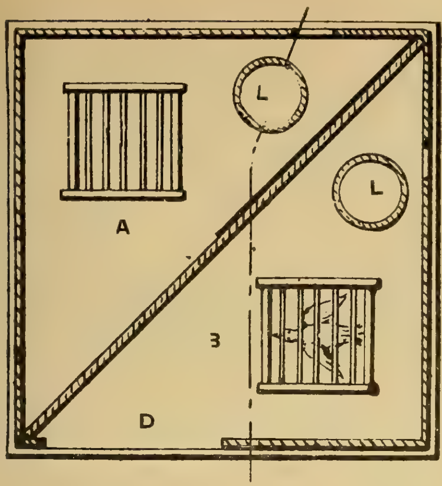



FIG. 2

FIG. 3

burning; the cage B, not being illuminated, will be invisible Now, if the lamp L is turned off, and the lamp L' turned on at the same instant, the observer will see the cage B by reflection from the diagonal glass partition C; although this glass is transparent the angle of the rays is such that there will be a sufficient amount of reflection to make the object clearly visible, and as can be readily verified by placing any object in front of a mirror turned at 45 degrees, the cage B will appear to the observer to be in the position of the cage A. Thus, a bird suddenly appears to be in the cage A.

An infinite variety of changes can be worked on the same princple; flowers may be made to appear and disappear in a vase; an aquarium can be alternately empty and alive with fish; a box of cigars may be made to appear and disappear, and so on. Two different sizes of the box are made for general use, as shown in the cuts (Figs. 3 and 4).

As a show window novelty this illusion should prove exceedingly attractive. Aside from its mere spectacular value in attracting and holding attention, it can be made to display an article with and without a price-mark, and a variety of tricks that should give it a long and continuous "run." The unlimited number of variations to which this ingenious device is adaptable is one of its most valuable features. It is not necessary that the change be affected instantaneously. By means of two rheostats (water rheostats can be made at a cost of a few cents by any electrician) the one electric lamp can be gradually extinguished while the other is as gradually lighted, which give the object the appearance of changing slowly into the other. Here is a suggestion for the patent medicine fraternity. ("Collier's Weekly" please take notice). Make two life size wax models of a face, the coloring as realistic as possible to represent life. Let one represent the picture of health, and the other the same face in an emaciated condition. The latter is lighted up first, with the placard, "Before taking." The lights are then slowly dissolved one into the other, thus exhibiting the actual progress of restoration to health by virtue of the particular medicine advertised.

It s difficult to conceive any toy which would afford more entertainment while at the same tnme stimulating orignality and inventive genius.

# Commercial Engineering of Illumination

## Explanation of Lighting and Power Contracts

By A. H. Keleher

It has been the experience of the writer that the great majority of Central Station customers sign blindly their contracts for electrical energy, being unable to grasp the full meaning conveyed by the technical and legal wording of the usual contract or agreement. An attempt is herein made, therefore, to take a few examples of the typical forms of contracts used broadly throughout the United States and dissect them to some extent, explaining phrases and clauses where it is thought such explanation to be necessary to be clear and full understanding of the contract.

The contract which is most familiar to the ordinary layman is the "Agreement for Electric Current—Retail Lighting," which reads partly as follows: "You are hereby requested to supply electric current for an equipment of about .... incandescent lamps, .... arc lamps, .... ventilating fans, etc., electric current to be supplied by your company for a term of one year from the commencement of supply......., at the rate of ten cents per kilowatt hour. No change shall be made in the equipment or in the type, size or number of lamps or other appliances connected therewith; nor shall current be used except for the equipment scheduled; nor other electric service introduced or permitted in connection with the equipment, without the previous consent of the................. Company. At the expiration of the stated term this agreement shall continue in force until terminated by thirty days' written notice from either party. This agreement shall not be binding upon the Company until accepted by it through its proper executive officer, and shall not be modified or affected by any promise or agreement or representation by any agent or employee of the Company unless incorporated in writing herein before such acceptance." Then follow the signatures of the intending customer and of the central station company.

Ten cents per kilowatt hour is the rate charged in the average large city. A kilowatt hour represents a definite amount of work done, and is roughly speaking equivalent to one hour's use of 20-16 candle-power standard Edison carbon filament lamps, or of two standard arc lamps or of 1 1-3 horse power in motors. Therefore it can be seen that at the above rate a standard carbon filament lamp costs to burn for one hour about one-half cent, and a standard arc lamp five cents, while to use a one-horse power motor for one hour costs about 7½ cents. Now that Tungsten lamps are coming into such general use, it is useful to remember the hourly cost of tungsten lamps as follows:

| | | | |
|---|---|---|---|
| 100 watt, | 80 candle power | lamp.... | $0.01 |
| 60 " | 48 " " | " .... | .006 |
| 40 " | 32 " " | " .... | .004 |

An ordinary 12″ to 16″ ventiating fan costs to operate about ½ cent per hour, can be rented for $2.00 per month and cost from $12 to $16 retail.

The clause in the retail contract requiring that no change in the equipment be made without the previous written consent of the Company is insisted on for the customer's own benefit, and is in accord-

ance with the requirements of the Board of Fire Underwriters. Electricity is a fairly safe proposition if the wiring is properly installed so as to minimize danger from fire, but if an amateur wireman re-arranges the wiring which has been previously passed upon by the authorized inspectors, a good chance presents itself for some inexplicable fire. It is to obviate this danger that central stations insist on having any new wiring brought to the attention of the Underwriters. Disregard of this duty of the customer results in the annulment of his fire insurance policy, as this penalty is attached to the failure of the policy holder to fail to conform to the requirement of the Board of Fire Underwriters.

The retail contract reads that it shall last for one year. Companies do not insist upon compliance with this provision, disconnection being made upon notice from the consumer.

Other terms and conditions are usually made part of the agreement. The company furnishes the meter and service appliances necessary to connect the customer's equipment with the mains. This means that the customer is required to wire to the basement or other point of entrance of the Company's wires. The customer must at all reasonable times allow access to the meters, and agrees to allow himself to be disconnected upon failure to conform to any of the conditions of the contract.

Payments on retail contracts are usually made monthly, but in case a new customer cannot give satisfactory references, by signing a "Weekly Clause," or a promise to pay weekly, current will be supplied to him without further delay. Some customers whose credit is perfectly good, rather than await the delay consumed by having references looked up, pay on the weekly basis. A company is usually willing to transfer a weekly customer to a monthly basis when asked to do so, provided that some time has elapsed during which time the customer has met his bills promptly.

### Retail Power.

The contract for retail power is in essential parts similar to the foregoing lighting contract, excepting of course in the matter of rates, which are lower because electrical energy corporations can sell the energy much cheaper when the demand comes on during the day, which is the case with the average motor installation. To encourage as large a use as possible a premium is put upon large consumption by the following sliding schedule:

For the first 200 kilowatt hours of monthly consumption, 10c. per K. W. H.

From 200 to 400, excess over 200 of monthly consumption 8c. per K. W. H.

From 400 to 3,500 excess over 400 of monthly consumption 6c. per K. W. H.

From 3,500 to 7,000 excess over 3,500 of monthly consumption 5c. per K. W. H.

A customer using 200 kilowatt hours or less is thus paying the same rate as he would under a lighting agreement. Over 3,500 K. W. H., the power is secured at the extremely low rate of 5 cents per kilowatt hour, which as has been seen is the equivalent of 1 1-3 horse power hours. Fans, hair dryers, small blowers, etc., do not come under this contract, but are charged for at lighting rates. Any motor larger than ½ horsepower is connected across the power meter. With the above rates of electrical power, electricity can now compete with other sources of power, and is used in the majority of cases where good, clean, efficient service is desired.

### Automobile and Storage Batteries.

Storage battery currents usually provide for selling the current at extremely low rates, ranging from 6 cents to 3 cents per kilowatt hour according to the extent of the consumption. It is usually agreed, moreover, between the contracting parties, that there shall be a minimum monthly charge of $50.00 for each installation supplied under the contract.

This stipulation, of course, works to the benefit of the central station. Its effect, on the small consumer, is to render to him useless this form of contract, because very often his bills would be smaller if paid for at the retail lighting rate. If a customer's bill for current should in any one year exceed what it would at the ten cent rate, the excess at the end of the year would be credited to such customer. Current rates for storage battery and automobile service are:

Six cents per Kilowatt hour, with discounts as follows:

For a monthly consumption of 3000 K. W. H, ½c. per K. W. H.

For a monthly consumption of 5000 K. W. H., 1½c. per K. W. H.

For a monthly consumption of 8000 K. W. H., 1½c. per K. W. H.

For a monthly consumption of 10000 K. W. H., 2½c. per K. W. H.

For a monthly consumption of 25000 K. W. H., 2½c. per K. W. H.

For a monthly consumption of 50000 K. W. H., 3½c. per K. W. H.

In order to provide for a balance on both sides of a three wire system, agreement is further made that current shall be made from both sides of the system simultaneously in approximately equal quantities. In practice this provision is usually more honored in the breach than in the observance. In consideration of the cheap rate under which current is sold for battery purposes, the user agrees not to use same during the hours from 4.00 p. m. to 10.00 p. m., during the months of November, December, January and February. The purpose of this stipulation is to prevent current being taken during the hours of the evening lighting peak., when the station is taxed to its utmost.

WHOLESALE LIGHTING CONTRACTS.

Just as in any other business, when dealing in electricity we find that the large consumer is given the better rate. To encourage the use of electricity on a large scale, the rate is fixed in inverse proportion to the consumption. Wholesale contracts are divided into three classes: Wholesale "A," Wholesale "B," and Special Wholesale. The first two cover lighting service only, while the third is for both light and power. If a customer burns on either of the first two contracts and uses large motors, these are charged for under the retail power rate.

The Wholesale "A" contract, which is pasted on as a rider to the ordinary lighting contract in such a manner as to cover the part thereof referring to the retail rate reads:

"In consideration of the rates under this contract, the customer agrees for ten months of the year to use and pay for not less than 2000 K. W. H.'s of electric current or the equivalent of two hours' average daily use of the total equipment; that the contract shall be deemed a yearly contract and payments shall be made monthly thereon on account thereof."

*(To be continued.)*

## Illuminating Engineering and the Complaint Department.

There is no friend like the converted enemy. A dissatisfied customer, though but one out of ten thousand, is a germ whose possibilities for evil can not be estimated. A complaint is the first symptom of the microbe of dissatisfaction, and should be dealt with instantly and effectively. As a first aid to the injured illuminating engineering is both safe and effective.

Mr. Harold Almert, of Wichita, Kas., gives the following valuable report of his experience with this treatment:

My experience has been that, in nine cases out of ten, complaints of high bills are due, not to fast meters, but to old lamps, poorly designed fixtures, bad shades, bad location of fixtures, etc. For that reason our meter men have been trained so that they understand the elementary principles of illuminating engineering, and whenever sent out to investigate a complaint of high bills, if the meter is found to be correct, an inspection of the premises is made to see the condition of the lamps and fixtures, location of the same and how they are used. On return to the office a written report is made, with recommendations for changes which ought to be made, stating kind of lamps, etc., which should be used—frequently, inexpensive alterations to the fixtures—also stating the probable increase of light without the additional increase of current which will result. This we have found to be very valuable, satisfying a great majority of complaints.

If the consumer is poor and, in the judgment of the inspector, can ill afford to pay a fair sized lighting bill, we then endeavor to reduce the consumption of current by putting in efficient lamps, shades, etc.: but if the consumer can well afford to pay a fair sized bill, we do not endeavor to cut down his current consumption, but increase his illumination by proper lamps and shades.

The work in this department is under the direction of a $75 man, and while he is not an expert, he is a student and a careful worker.

Have not heard of any other company using this method of handling complaints, but I believe it is well worth the while for every company to consider the same.

## Getting Lighting Results.

Whirling through the country of an evening .on a fast train or journeying more leisurely through rural communities by trolley, the traveling business man realizes what an enormous waste of opportunity is caused by the non-development of resources that are within the retailer's grasp. Effective store frontage and window trimming are important among these items, but far more important and far more reaching out in its effect, is that of store lighting. There are numbers of small towns where electric power is supplied to the residents by some large manufacturing plant located in or near the town site. More often than not the current thus supplied is inefficient and produces a very mediocre quality of light. Frequently single electric bulbs of 16-candle power dangle in a shop window and at uneven intervals throughout the store forming the only means of lighting the windows and interior. Exterior lighting is entirely absent and upon extremely foggy nights one has to find their way to the store by a sense of touch and instinct rather than by any guiding ray of illumination. In towns where gas is supplied, either natural or artificial, the majority of dealers confine themselves to the ordinary fishtail burner, while a few of the more courageous put in expensive mantles on their burners and thus a somewhat greater efficiency is secured than their neighbors enjoy.

As the towns grow larger in size and greater in commercial importance one occasionally notices some enterprising merchant who has installed a gas plant of his own, either acetylene or gasoline, and this usually secures a satisfactory amount of efficiency. The regrettable part, however, is the fact that most dealers do not attempt to better themselves in this matter, and they do not realize that it is possible with a given current of electricity or with a given supply of gas, to increase the efficiency of the current or gas supply by the use of lamps and burners properly suited to conditions. The difficulty on the part of the manufacturers of these appliances seems to be to get hold of the man who actually needs these goods, while the difficulty on the part of the man who needs them is to find the manufacturer who turns out such a product. For those dealers who are located in towns where there is no electric or gas plant, there are a number of good acetylene and gasoline gas plants which may be installed at a comparatively small cost and which will give the maximum of results. True it is that some of these systems have caused trouble, but still more true it is that other systems which are absolutely safe under insurance restrictions and which do not either increase your insurance rate or your risk in any way. Undoubtedly it would be of advantage for several merchants occupying a row of stores or a block of stores to install the one system, each paying his proportionate part of the installation and running expense. Or better still, it would be desirable for you to put the matter before your landlord and have the installation of such a machine added to your rent, thereby increasing it only by a nominal sum and acquiring the benefit of the complete expenditure at once.

As we have suggested there are a thousand and one ways to get around the difficulty of poor accommodations in lighting matters, and the main trouble seems to be to get hold of the man who is actually desirous of ? ??
—*Shoe and Leather World.*

## Announcements.

The Electrocraft Publishing Co., Detroit, Mich., announce that the Third Edition of the Electrocraft Illustrated List of Approved Electrical Supplies will shortly be issued, and that copies will be sent free of charge) only to actual buyers of electrical supplies and persons directly influencing buying. The publishers request immediate applications for copies, to be made on the letterheads of the applicants and accompanied by ten cents in stamps or silver to pay postage.

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Mr. Will M. Dixon and Mr. Howard F. Smith announce that they will conduct a general engineering business under the firm name of Dixon & Smith, with offices in the Wright Building, St. Louis, Mo. Mr. Dixon was connected with the electrical department of the Pan-American and Louisiana Purchase Expositions, and was Chief of the Department of Electricity of the Jamestown Exposition. Mr. Smith has been with the New York Lght, Heat & Power Co., and was with the mehanical engineering department of the St. Louis Exposition.

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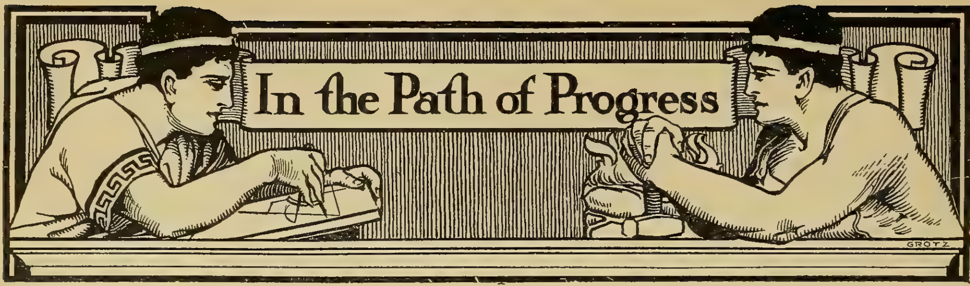
The next annual convention of the Colorado Electric Light, Power and Railway Association will be held at Glenwood Springs, Colo., September 16th, 17th and 18th, 1908.




# The Flaming Arc Lamp.

When the flaming arc lamp was first publicly exhibited in this country some three years ago, the various lighting interests were inclined to look upon it as a mere nine days wonder, which might have a certain vogue for advertising purposes, but would never become a serious factor in the general illuminating field. It is doubtful, however, if any new light-source ever sprang into such instant popularity. From the moment the first lamps were shown on Broadway the demand for them seemed to spring up spontaneuosly, and for more than a year the only difficulty commercially was in securing lamps to supply the demand. This was due to a considerable measure no doubt, to the fact that the experimental work in connection with both lamp and carbon had been very thoroughly worked out abroad before it attracted any attention in this country. The first lamps that were imported and marketed are still in successful operation; there were no discouraging failures to be charged up to the expense accounts of the users and explained away by the dealers. As the flaming arc lamp had been worked out to an assured success and put into practical use in Europe some time before being used in this country, it is curious that American manufacturers did not foresee its possibilities; but they did not, and before they fairly knew what was happening an imported lamp of good construction had secured a permanent foothold and the cream of the business.

As was inevitable, however, the American manufacturer, as soon as he saw that the flaming arc was really here to stay, rushed into the breach and sought to establish himself before any further conquests of his market by foreign makers could be accomplished.

The imported lamp which has enjoyed such a phenomenal success, both commercially and practically, uses what is commonly known as the clock-work regulating mechanism. This mechanism was used in the first open arc lamps, but was soon displaced by simpler devices. As might be expected, American designers generally shied at a revival of this older and more complicated system; a number of them attempting to replace it with the equally old method of allowing the carbons to rest upon a stop to which they feed down by gravity as the points are worn away by the arc. A great deal of expensive experimenting has been done to Americanize the flaming arc lamp, and within the past

G. I. FLAME ARC LAMP

few months several new forms have been announced. One of the most recent of these is manufactured by the General Electric Company, the essential features of which are described as follows:—

The General Electric Company is now placing on the market a line of flame arc lamps of the inclined carbon type and parallel rod construction. The mechanism of the lamp is an adaptation of that used in the well-known series arc lamps of the same make, and consists essentially of a differential winding with an adjustable weight actuating a single clutch which feeds both carbons simultaneously. This construction is simple and rugged, assures positive operation and eliminates from the lamp the objectionable features of clock-wheel trains, cables, chains, ribbons, etc.

The low arc voltage of these lamps, 42 to 45 volts, enables them to be most efficiently operated in multiple series on standard lighting circuits with two across 100 to 125 volts or four across 200 to 250 volts. They can, however, be operated singly if desired, in which case a separate resistance is used with the direct current lamps. The direct current lamp when operated two in series requires no external resistance. A suitable regulating reactance is furnished with the alternating current lamps for either series or multiple operation. The reactance is separate from the lamp itself and is enclosed in a neat compact casing.

The lamps are of pleasing design and are furnished with either copper or steel casings. The carbons used with this type of lamp are 400mm. long and have a life of from 10 to 12 hours. For alternating current lamps both carbons are 10mm. in diameter, while for the direct current lamp the positive carbon is 10mm. in diameter and the negative 9mm. The standard winding is for 12 amperes.

As these lamps are used largely for outdoor lighting, such as the front of stores, theatres, large signs, amusement parks, and other places where a well constructed, weather proof lamp is necessary, the parts are made extra strong and are all heavily galvanized.

THE STAVE FLAME ARC LAMP.

The Stave Electrical Company of New York have produced a flaming arc lamp of special design, for which they make the following claims:—

The "Stave" electric lamp is one of the lamps that embodies the valuable experience that they have built on the principle of rough and rugged construction near the arc chamber, good and reliable construction of the regulating mechanism. It has been realized that a lamp must work equally well on either two in series on 110 volts or 10 in series on 500 volts. This can only be obtained by a well proportioned and well calculated differential winding of the feed mechanism. It has been the constant aim to construct the lamp in such a way that there was no need of readjusting the lamp together for a certain circuit, but any desired number of lamps could be put up on voltage ranging from 110 to 5,000 without any readjustment Every lamp will simply burn at the proper voltage, namely 45 volts, and as soon as this voltage by reason of the natural consumption of the current, is increased to 46 or 47 the feeding mechanism infallably comes in operation. The upper part of the lamp containing this

mechanism is entirely sealed, and in many years' experience it has not been found necessary to break this seal, except in case of very heavy outside damage. Each lamp contains an internal resistance so adjusted that the lamp is read for immediate use on 115 volt circuits, that is to say, two burning in a series.

Another great advantage of this lamp is that it entirely does away with the porcelain economizer which has been a source of trouble in other lamps. The whole bottom part is made of cast iron and steatite guides, the latter being arranged an inch or two above the arc and thus absolutely avoiding the splitting or cracking of same through excesssive heat.

All the necesary fluxibles are made by very fine stranded copper wire threaded with glass beads. This has proved to be the finest class of insulation obtainable, as the glass is absolutely impervious to the fumes and every individual bead automatically cleaning the next one through constantly changing its position.

All the current carrying parts of this lamp are sufficiently insulated from the body of the lamp by air and mica only.

A great deal of attention has been paid to the construction of the carbon holders, as it has been found that through constant use of same the screws easily break off. A very substantial and easily accessible thumb screw has been provided for this purpose, thus not tempting the trimmer of the lamp to use his pliers and so break off the screw.

On the whole the workmanship is of the highest class throughout, and every little electrical and mechanical detail has been carefully thought out.

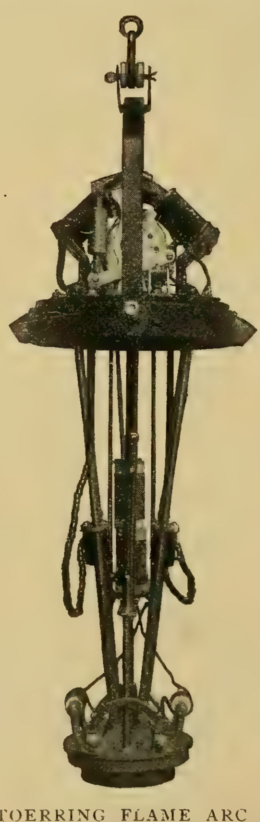
The C. J. Toerring Co., of Philadelphia, have achieved distinction in the arc lamp field by reason of sensible design and thoroughly good constructioin. They were the first to put a 200 hour enclosed lamp on the market. They now come out with a new flame arc lamp, which may be assumed to possess the general merits of its predecessors. The following description is given by the makers:

The lamp is operated by a differential shunt-series magnets. The carbons are suspended from chains wound on drums and are fed downward gradually and accurately.

This portion of the lamp has received very careful attention, which its great influence on the steadiness, feed and illuminating efficiency of the lamp compels. In most lamps a magnetic blow-out placed above the arc has been deemed sufficient. Realizing its great importance, we have designed an arc positioner or magnetic blow out, by carefully exploring the whole of the magnetic field to which the arc is subjected, and designing it in a manner to give maximum efficiency to all parts of the field, The coils are constructed of wire with fire-proof insulation, each turn of which wire is laid n a separate groove of lava insulator, doubly insulating it from the iron core.

In the design of the arc striking mechanism all small and delicate parts have been eliminated, the whole being reduced to two heavy barrels, so mounted that a slight rotation transmitted to them through a rod from the armature causes the carbon ends passing through them to approach or recede, as the case may be, from one another. A large amount of friction is elminated and accurate adjustment of arc length is made a certainty. Movement is transmitted to these barrels by a rod which is directly connected with the armature, of the regulating magnets.

The feed of the carbons is accomplished, as already mentioned, by gravity, the time element being secured by the interposition of a train of gears. These gears are made especially heavy, the shafts and pinions being turned up from bar german silver.



THE TOERRING FLAME ARC LAMP MECHANISM.

THE U. S. FLAME ARC LAMP.

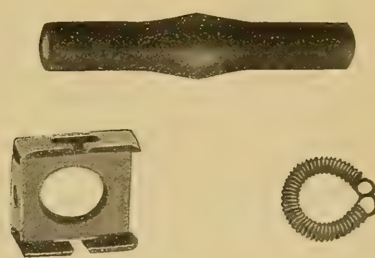
The United States Flaming Arc Lamp has at least a distinguishing name, and is one of the very latest aspirants for public favor. Simplicity is the chief virtue claimed for this new lamp; it has neither "blowing magnets" nor "economizer." It has been in successful operation abroad, a total of some 10,000 lamps being now in use.

## Miniature Arcs.

With the introduction of the flame arc lamp interest was revived in arc lamps of smaller current consumption, generally known as "miniature" arcs. Lamps of this character have long been in practical use in Europe, where saving of current is of greater importance than saving in the labor required in maintenance; and repeated efforts have been made to secure their general adoption in this country. Small arcs, consuming from 2½ to 4½ amperes are now offered by the Excello Arc Lamp Co., the U. S. Arc Lamp Co., and Queen & Co.

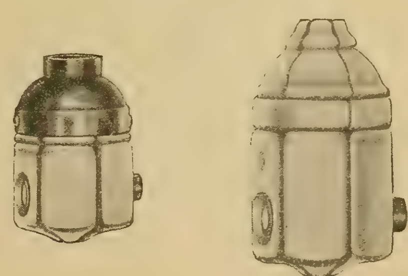
## An Improved Design of Electric Sockets and Switches.

The Cutler-Hammer Manfg. Co., of Milwaukee, have devised an electric switch which seems to be the absolute limit of simplicity in construction; and simplicity is unquestionably the cardinal virtue of all mechanism. This switch is made up for use on side walls or in what is commonly known as the pendant form, and is also applied to lamp sockets. The switch consists of a sliding rod which is pushed interested in keeping thoroughly abreast ing the circuit in one position, and making it in the other. Thus, in turning on or off



THE THREE ELEMENTS OF THE CUTLER-HAMMER SWITCH.

a lamp in a socket made on this principle it s only necessary to push the button or end of the rod. This construction permits of porcelain being used in lamp sockets, which has long been desired by users, and particularly by the underwriters. Serious accidents, not infrequently resulting in death, have occurred from the use of metal for the shells of lamp sockets. This new line of switches should be carefully examined by all electrical contractors, architects, and illuminating engineers who are interested in keeping horoughly abreast of the improvements in electric lighting.




# American Items

## New Books.

ELECTRICAL CONTRACTING, by Louis J. Auerbacher; McGraw Publishing Co., New York. $2.00 net.

The volume is not large, but the matter strictly up-to-date, concise in treatment, and dealing with the essentials of the subject Matters treated include Shop System, Estimating, Wiring and Construction Methods, and Hints on Getting Business The suggestions for shop system are good and practical, and the forms for keeping records particularly commendable. Their use would prevent many of the losses occasioned by neglect to keep close accounts of materials, labor and cost on different contracts. The book contains just the directions in regard to electric wiring which illuminating engineers should know.

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TESTS OF INCANDESCENT LAMPS: *Municipal Journal and Engineer,* August 12th.

The report of a series of tests in carbon, metallized, and tantalum filament lamps made at the Engineering Station of the University of Illinois The results ob- those that have been frequently reported from other sources.

ORNAMENTAL STREET LIGHTING IN MINNEAPOLIS, by R. H. McGrath. *Electrical World.*

Describes the installation of decorative street lighting recently put into service in that city.

DENVER'S ELECTRICAL GREETING, by John M. Connelly; *Western Electrician,* July 25th.

A short descriptive, illustrated article on the special lighting in Denver during the Democratic National Convention.

TUNGSTEN LAMP FALLACIES, H. Thurston Owens; *American Gas Light Journal,* July 20th.

Mr Owens claims that the average life of the present commercial tungsten lamp is less than that claimed by the makers, and shows that, with best forms of inverted gas burners, gas lighting is still cheaper than electric light on the basis of a dollar per 1000 for gas, and 10c. per K. W. H. for electric current. He also criticizes some of the tungsten lamp fixtures that have been recently placed upon the market

MERCURY VAPOR LAMPS FOR RAILWAY USE. Editorial; *Electric Railway Journal,* August 8th.

Comments favorably upon the use of this form of electric light for the illumination of railway shops.

SELECTIVE RADIATION FROM THE NERNST GLOWER. W. W. Coblentz; *Bulletin of the Bureau of Standards,* May.

An exhaustive and highly technical investigation of this interesting theoretical subject.

THE ELECTRIC LIGHTING SYSTEM OF WASHINGTON, D. C.

Substantially the same article appears in the "Electrical Review" and the "Electrical World" of August 1st.

JAPANESE WINDOW DRESSING, *Merchants' Record and Show Window,* August.

An exceedingly interesting illustrated article showing methods used by Japanese merchants in displaying their wares. One view of the exterior of a Tokio store shows that the Japaese are fully alive to the advantages of spectacular lighting by way of outlining and window illumination.

# Foreign Items.

COMPILED BY J. S. DOW.

ILLUMINATION AND PHOTOMETRY.

ETUDE DES PRINCIPALES SOURCES DE LUMIERE, by A. Broca and F. Laporte (Bull. Soc. Int. des Electriciens, June p. 277).

This paper treats of the effect on the eye of various illuminants. Among other experiments the authors investigate the effect of the mercury-vapour lamp and the carbon filament lamp on the speed of reading, visual acuity, and the contraction of the pupil-aperture. They appear to have found but little difference ascribable to the colour of these two sources. As regards visual acuity, the intensity of illumination appears to be the important factor, and the authors recommend an illumination of the order of 20 to 40 lux.

They also refer to the effect of bright sources of light on the eye, and particularly emphasize the necessity of keeping such bright points of light entirely out of the range of vision, so that they are not to be seen even out of the tail of the eye. Curiously it was found that in some cases the presence of such a bright source increased visual acuity . . . but only at the expense of fatigue.

DIE SCHADDIGUNG DES AUGES DURCH DIE EINWIRKIRUNG DES ULTRAVIOLETTEN LICHTES,. by Drs. Schanz and Stockhausen. (*E. T. Z.*, June 25).

This paper was read before the annual meeting of Verband Deutscher Elektrotechniker, but has only appeared in abstract as yet. The authors point out that ultraviolet light is injurious to the eyes and that ordinary varieties of glass do not provide sufficient protection, because they allow rays in the neighborhood of 0.4 to 0.3m to pass, and these rays are said to be exceptionally severe. The authors have therefore devised a type of glass to meet this objection which they term "Euphos" glass; this is said to be completely impervious to the objectionable rays.

REPORT OF THE COMMITTEE ON PHOTOMETRY OF THE DEUTSCHER VEREIN VON GAS- UND WASSERFACHMANNERN, (*J. f. G.*, June 20.)

The main question discussed by this committee is the applicability of the rules adopted by the Verband deutscher Elektrotechniker to the photometry of gas-lights. The committee accept the mean lower hemispherical C. P. of sources of light as the best basis of comparison, though they also point out that this criterion must be employed with reserve in certain practical cases.

The report also contains a resume of methods of obtaining polar curves and some details of the testing of gas, etc., Of special interest are the results of the experiments that have been in progress on the effect of transmitting gas at high pressure from Lubeck to Travemunde. It seems to be agreed that this had but little effect on either the calorific or illuminating power of the gas.

INTEGRIERENDES PHOTOMETER, by H. Kruss, (*J. f. G.*, July 4).

Kruss describes a form of integrating mirror photometer contrived on the Matthews principle but utilizing a different method of concentrating the light from the individual mirrors. In all such photometers some method of introducing the factor. "Cos a," "a" being the angle at which the individual ray strikes the mirror, must be adopted in order to integrate the total light correctly. Matthews employed a series of smoked glasses for this purpose, and Blondel a series of slits in a globe, surrounding the mirrors, which was rotated. Kruss utilizes a series of lenses which concentrate the light on the photometer-screen and introduces the necessary factor by means of stops of suitable diameter placed in front of each of them.

VERGLEICH DER VERSCHIEDENEN METHODEN ZUR BESTIMMUNG DER MITTLEREN HORIZONTALLICHTSTARKE VON METALLFADENLAMPEN, by C. Paulus, (*Z. f. B.*, June 30).

Paulus comes to the conclusion that neither the method of measurement in a single

direction nor the mirror methods of determining mean horizontal C. P. are satisfactory in the case of metallic filament lamps, since both depend upon the assumption that the lamp yields an approximately symmetrical distribution of light. The rotating method he has found to give much better results. He finds that a speed of rotation of 40 to 80 per minute is sufficiently low to obviate the danger of distorting or breaking the filament in rotation, while the formation of "flicker" on the face of the photometer was not sufficiently marked to interfere seriously with the accuracy in reading.

NEUES TRAGBARES PHOTOMETER FUR ELEKTRISCHE GLUHLAMPEN, (*Z. f. B.*, June 30).

A form of portable photometer for the testing of glowlamps. The photometer is of an enclosed pattern and is brought out by the Messrs Siemens and Halske. It utilizes the angle-mirror method. An interesting feature is the use of a special form of "grease-spot" screen composed of two sheets of frosted glass, between which a silvered spot is placed.

METALLISCHE LEUCHTFADEN UND METALLFADENLAMPEN IN DER FABRICATION UND IN DER PRAXIS (*Elek. Anz.*, July 5 and 16).

An article devoted to recent processes in the manufacture of glowlamp-filaments, etc., and accompanied by references to the recent patent literature of the subject.

BEITRAG ZUR KLARUNG DER FRAGE BETREFEND DIE KUFTIGE ENTWICKERLUNG DER EINWATTIGEN LAMPE UND DER ELEKTRISCHEN BELEUCHTUNG, (*E. T. Z.*, June 11).

DER EINFLUSS VON UBERSPANNUNGEN AUF DIE LEBENSDAUER VON METALLFADEN-GLUHLAMPEN. (*E. T. Z.*, June 25).

VERGLEICH VON BETRIEBSKOSTEN KLEINER GOGENLAMPEN UND HOCHKERZIGER OSRAMLAMPEN. (*E. T. Z.*, June 25).

All these three papers are by Remane. The first takes the form of an article in the "Elektrotechnische Zeitschrift," and considers the prospects of the one watt per candle incandescent lamp. The author urges that a 200 volt 16 C. P. lamp is really not asked for to-day either by consumer or supply company, and certainly not by the lampmakers. He points out that the gas companies utilizes lights of 50 to 60 C. P., and would ridicule the idea of 16 C. P. sources. Now that a sufficient glow lamp is to hand the consumer can obtain his light as cheaply as by gas, even if he is driven to use lights of high candlepower. Remane therefore urges that the consumer ought to be satisfied to get more light for the same cost rather than to expect to cut his cost of lighting down on the basis of the old intensity of illumination. All this is illustrated by comparisons between the cost of gas and electric lighting.

In conclusion the author expresses the hope that lampmakers will be driven to produce high voltage lamps, for it is well known that such lamps cannot be produced as successfully as those intended for low pressures.

The other two articles deal with the effect of over-running metallic filament lamps and the comparison of the costs of upkeep of small arc lamps and high candle power metallic filament lamps respectively. The papers have, however, only been reproduced in abstract as yet, and may be referred to in greater detail when the full reports are at hand.

DIE JUST-WOLFRAM LAMPE FUR 220 VOLT, (*E. T. Z.*, June 4, 1908.)

A resume of some tests on the 220 volt tungsten lamps, carried out at the Reichsanatalt. The tests were carried out on both D. C. and A. C., and in both cases led to favorable results, the lamps burning at about 1.25 watts per H. K. for in many cases well over 100 hours.

UBER ELEKTRISCHE STRASSENBELEUCHTUNG DEREN SYSTEME UND HIRE RATIONELLITAT, (*Elek. Anz.*, July 23), by J. Schmidt.

The author discusses the various factors on which the choice of the most economical system of illumination depends. Apart from the mere cost of energy required to yield a given illumination we have to bear in mind the cost of service, and the price of labour in the particular country involved, the system of supply, the length of time for which the various lamps have to be kept burning each night, etc. In connection with this last point the author gives a table showing the hours that lamps, intended to run all night or half-nightly must be kept on throughout the

various months of the year. The paper is chiefly interesting as showing the diversity of factors on which the cost of electrical street-lighting depends.

BOGENLAMPEN INDIKATOR, (*E. T. Z.*, July 2, *Elek. Anz.*, July 9).

A description of an ingenious device which serves to show when one of a series of arclights, at some distance from the observer away and out of sight, is not burning well. A glow-lamp is placed on a central board in parallel with its respective arclamp, and when the latter burns unsteadily and hence the P. D. across the carbons fluctuates, these variations immediately become apparent by the flickering of the glowlamp. The observer can thus see at a glance which of the arclamps needs attention.

FORTSCHRITTE IN DER GLUHLAMPEN-INDUSTRIE, (*Z. f. B.*, July 10.)

The conclusion of a series of articles dealing with recent developments in the manufacture of glowlamps and glowlamp filaments, including references to the most recent Patent Literature on the subject.

## GAS OIL, AND ACETYLENE LIGHTING, ETC.

THE ANNUAL MEETING OF THE SOCIETE TECHNIQUE DE L'INDUSTRIE DU GAZ, (*G. W.*, June 27).

At the annual meeting of this society, which is abstracted in the British gas journals, several short papers of interest to the illuminating engineer were read, though none of them dealt specifically with illumination. One subject of interest was that of the use of hydrocarbons derived from coal-tar for incandescent lighting. This method is exemplified by the "Lusol" lamps used in Paris; such lamps, besides having the advantage of portability, are said to be very economical.

A SIMPLE DISCOVERY INCREASES LIGHTING EFFICIENCY, (*J. G. L.*, July 14).

An ingenious little device for increasing the efficiency of incandescent burners. A conical solid body made of some refractory material is slipped over the support holding the mantle and serves to guide the flame onto its surface and secure more perfect incandescence. Probably it also serves to increase the flame-temperature. At any rate it is claimed that an increase in efficiency of 20 per cent. is gained by this means.

Another advantage claimed is that the life of the mantles is improved partly because a stiffer flame is secured and partly because the presence of the heated body modifies the rapid change of temperature that usually occurs when a mantle is lighted up or extinguished.

Among other items of interest mention may be made of:—

UDER DIE OFFENTLICHE BELEUCHTUNG IN BERLIN, by Dr. Drehschmidt, (*J. f. G.*, June 27).

A short contribution on the subject of the public lighting of Berlin.

TESTS BY W. WEDDING ON THE KEITH HIGH PRESSURE INVERTED LAMP, (*J. G. L.*, July 14).

VERFAHREN ZUR HERSTELLUNG VON GLUHSTRUMPFEN, (*Z. f. B.*, July 10).

A description of recent developments in the manufacture of incandescent mantles.

THE INTERNATIONAL CONGRESS ON ACETYLENE, PAPERS READ BEFORE, (Acetylene, July).

L'ECLAIRAGE DES CHEMINS DE FER, (Rev. des Eclairages, July 15).

A short article dealing with the lighting of railways by acetylene.

# Miscellaneous News

CHICAGO, ILL.—Pursuant to the terms of the ordinance recently passed by the city council and accepted by the Commonwealth Edison Company, a cut in rates for electric lighting of 13 1-3 per cent. went into effect July 31. The effect is to make electricity one of the cheapest forms of illumination, and it is expected to result in a much wider use of the current. The new rates will stand for a year, when an additional cut will be effected, that rate to stand for three years, or until the expiration of the grant. The reduction effective on the above date marks a decrease in the cost of electric light of more than one-third since 1905. The new rate is 12 cents a kilowatt hour for the primary portion of use and 7 cents for the low-rate portion, allowing 1 cent per kilowatt hour for payment of bills within ten days. The old rate was 14 and 8 cents, and in the early part of 1905 it was 20 cents and 10 cents.

MINNEAPOLIS, MINN.—After a fight of more than a year the City Council has won a victory over the General Electric Co. by forcing it to accept an ordinance providing a maximum net rate of 9 cents a kilowatt hour for electric service. The result of the fight on the company will be of great benefit to the private consumers, and the city of Minneapolis has forced down the price of street lighting from $84 an arc lamp to $65. The former maximum rate to private consumers was 14 cents a kilowatt hour. Consumers will benefit to the extent of 4 or 5 cents a kilowatt hour, while the city has reduced the cost of street lighting approximately 23 per cent. Since June 1, 1907, the city of Minneapolis refused to pay its lighting bills at the old rate of $84 a lamp. The General Electric Co. has agreed to take $70 a year for all of the unpaid lighting bills, the city benefiting $14 a lamp by its stand. The General Electric Co., under a new management, will be allowed to make a merely nominal charge. This charge for lighting consumers will be $1 a month.

MORRISTOWN, N. J.—The Morris and Somerset Electric Company, which was organized by local and Somerset County capitalists to furnish cheap and good electric light service to this city, Morris township, Mendham, Chatham, Bernards and Hanover townships, has won its fight against the Public Service Corporation. A 200 years' lease of the electric lighting plant and the franchise here has been turned over to the Morris and Somerset Electric Company.

PROVIDENCE, R. I.—The Board of Aldermen concurred in the Common Council resolution making a five-year contract for electric arc and incandescent lights with Power Company at $120 a year, for 2000 candle power arcs, and $30 yearly for 40 candle power incandescents.

ST LOUIS, MO.—W. V. N. Powelson has resigned as general manager of the Union Electric Light and Power Company, and his membership of the Board of Directors of the North American Company, owner of the three big utility corporations of St. Louis, the Union Electric, Laclede Gaslight and United Railways companies. Arthur Williams, contract agent of the New York Edison Company, New York City, will be the new general manager. He was selected by John I. Beggs of Milwaukee, managing director of the North American's interests in the West. Mr. Williams is called a protege of Mr. Beggs. He received his early training under Mr. Beggs when the latter was with the New York Edison Company in a managerial capacity twenty years ago. Mr. Williams, it is stated, will receive a salary of $25,000 a year as general manager of the company. Mr. Powelson was paid a salary of $10,000.

WINNIPEG, MANITOBA.—With the rise and progres of Western Canada cheap lighting is no small factor. Within the past few years acetylene has come to the front and may now be found in rural homes, hotels, churches and on automobiles and bicycles, in fact any place where artificial light is required. During the last five years the following towns have adopted acetylene for town plants, lighting their streets as well as their places of business and homes: Moosomin and Yorkton, Sask.; Gladstone, Deloraine, Souris and Manitou, Manitoba, where it is giving satisfaction.

The
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## *Contents of this Issue:*





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# *The Symbolism of Light*

*"There's nothing either good or bad*
*But thinking makes it so."*

*What is the greatest thing in the world today?*

*Sentiment.*

*Sentiment rules the rulers of nations; molds the character of the young; tempers the winds of adversity; solaces old age; inspires the genius; sets at naught the schemes of the crafty; confounds the logician; outwits the politician; puts man in the seventh heaven or in the depth of hades.*

*Sentiment finds its outward expression in symbols. Of what varying sentiments is light the symbol?*

*Of all symbols light in its various manifestations is the most expressive and impressive.*

*To properly light the home involves much more than the mere supplying of a certain amount of luminous rays. That which is signified by the word "home" is of a complex nature, embodying the finest, as well as the most powerful sentiments of the human mind, and these should find expression in its illumination. Brilliancy signifies welcome, good fellowship, sincerity: it should therefore greet the guest and pervade the living room. Shadow suggests rest and quiet meditation: let there be perceptible shadow in the library and studio. Specially directed and ample illumination befits the workshop and the laboratory: have such light in the kitchen and sewing room. Green and blue tints cause an unnatural pallor to the features and a cold and forbidding air to inanimate objects: keep such light out of the parlor or drawing room. The bedroom is the inner sanctuary: light it to suit your own individual fancy.*

*The most unspeakable horror conceivable by the human mind is the dungeon. Man flees from darkness as instinctively as the plant grows toward the light. If you wish to depopulate your city or town keep its streets in darkness; but if you would welcome the stranger within your gates so cordially as to make him wish to remain always with you, let him find brilliantly and artistically lighted thoroughfares. The feeling of welcome, of cheerfulness and of optimism thus created will produce a more profound and lasting impression than reams of printed matter setting forth the advantages of your town. The reason may be hard to convince: sentiments, which are the real springs of action, are formed in spite of reason. Light always has been and always will be the symbol of life, hope, cheerfulness and progress.*

*Let us have MORE light.*

E. L. Elliott.

# Lakeside, Denver's "Great White City"

By W. E. Comer.

The Denver Gas & Electric Company has recently been established an Illuminating Engineering Department, with R. G. Gentry, W. E. Comer, G. E. Williamson, A. W. Hahn, and R. B. Mateer, engineers in charge.

The company felt there was a growing demand for this department and the hearty approval and willing co-operation which they had received from the architects, contractors, builders, and merchants, are proof positive of the great good the department will be able to render the public. The fruits of their efforts are to be seen in the streets, homes, public buildings and stores throughout the city. The most notable, however, is Lakeside, "The Great White City of the West."

This is the largest single electrical installation ever made by a central station, and the Denver company is justly proud of this most beautiful resort. With its installation of over 65,000 lights, the resort covering 22½ acres, is one solid blaze of light, and offers a sight never to be forgotten.

The magnificent tower over 195 ft high supports a search-light which throws a stream of light upon the surrounding foothills for miles away. This tower, with its 15,000 lights, studded so closely that it presents a veritable pillar of fire, and when viewed from the miniature railroad on the opposite side of the natural lake, about a mile away, paints a mental picture so beautiful, grand and inspiring that time will never efface.

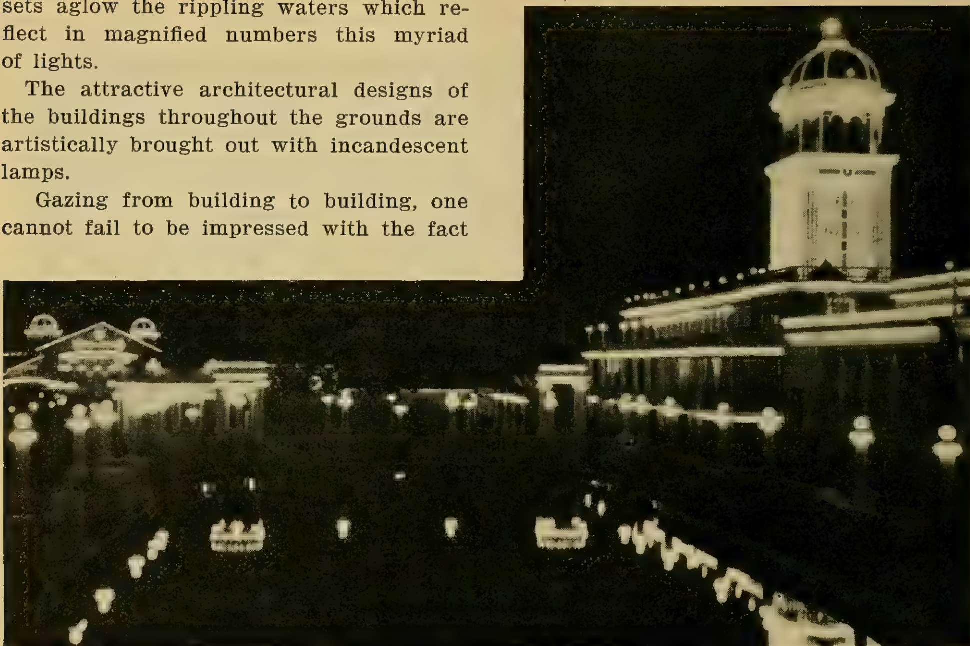
This lake is outlined with 4700 lamps, arranged in clusters of seventeen, forming a ball of fire on the top of the posts, which are fifteen feet in height. This unique arrangement affords a perfect illumination on the borders of the lake, and

W. E. COMER

sets aglow the rippling waters which reflect in magnified numbers this myriad of lights.

The attractive architectural designs of the buildings throughout the grounds are artistically brought out with incandescent lamps.

Gazing from building to building, one cannot fail to be impressed with the fact



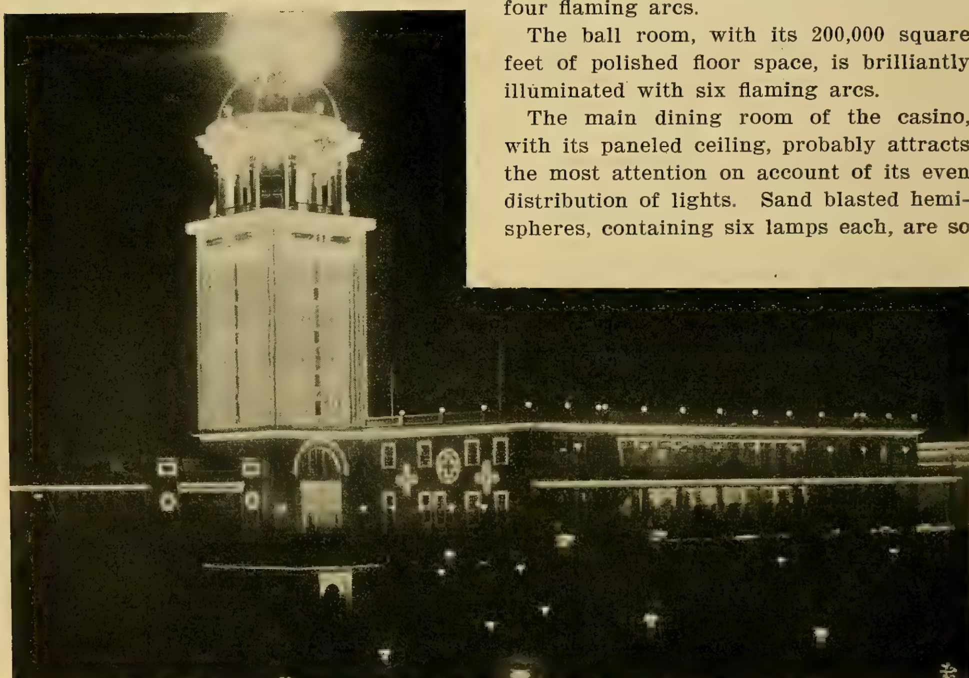
THE LAGOON.

that electricity is a most powerful factor which must be used to give life to architectural ideas.

The interior of the natatorium, which is 50 ft. by 150 ft., is well illuminated with four flaming arcs.

The ball room, with its 200,000 square feet of polished floor space, is brilliantly illuminated with six flaming arcs.

The main dining room of the casino, with its paneled ceiling, probably attracts the most attention on account of its even distribution of lights. Sand blasted hemispheres, containing six lamps each, are so



CASINO AND TOWER.

THE BALL ROOM.

placed in the ceiling that no shadows appear.

That the science of illuminating engineering can be profitably applied to commercial enterprises has been demonstrated at Lakeside.

THE CONCERT HALL.


REPRODUCTION OF A FULL PAGE HEADING FROM A SUNDAY EDITION OF ST. LOUIS POST DISPATCH.

# The Remarkable Progress of Illuminating Engineering in America.

Illuminating Engineering as a distinct branch of science is so young that those who were definitely interested in it ten years ago are the veterans of today. The infant science at that time had not yet even been christened, although the term "lighting engineer" had been used in a paper presented to the New York Electrical Society on the subject of the utilization of artificial light. Illuminating engineering, actually recognized by this name, belongs entirely to the present century; and the number of "veterans" at the present time can be counted on the fingers of one hand.

In view of its present status, the rapidity with which the science has been accepted and taken its place among established professions has no parallel in history. This phenomenally rapid growth has been due to several causes. In the first place, the revolution in the production of artificial light which had been brought about by the simultaneous invention of the electric light and the Welsbach gas burner had prepared the soil for a science of illumination, but it had been left untilled so long that it had become overgrown with the weeds of ignorance, prejudice and gross malpractice. Not only had a very considerable part of the advantage in efficiency which these new light-sources produced been lost in the utilization of their light, but the proportionately great differences in their hygienic effect upon the eyes been almost entirely overlooked. Eyes, pocket-books, and tempers had suffered an equal strain; and the long neglected and abused user of light was as ready to welcome reform as were the Cubans to welcome our battle-ships.

The seeds of illuminating engineering most assuredly fell on fertile ground; and yet, as might be expected, stony places were not wanting. Commercialism is of all things conservative; changes mean expense and uncertainty, The new method may be better, but the old one pays. It must be said to the credit of the makers of light producing apparatus, however, that they not only offered no obstructions to the progress of the science of illuminating engineering, but were among its most effective promotors.

The makers of lighting accessories did not exhibit the same foresight. This arose

from an entire inability to grasp the situation, which was the natural outcome of their complete ignorance on the subject of illumination. What makers of fixtures or accessories ten years ago knew, or cared, or so much as gave a thought to the illuminating results which his apparatus would give? He had been making the same things that his father and his grandfather had made, and what was all this new-fangled jargon about condlepower and distribution to him? He wanted no upstart, school-bred "engineer" to tell him how to polish brass tubes and copper plate iron castings. As to the shade-maker, he was blowing glass in essentially the same manner that the Egyptians used in the time of the Pharaohs, and had as little idea of the effect of his wares upon the distribution and diffusion of the rays from the light-source as did the mummy of Rameses I. Electrical engineers and architects, whose particular business it was to see that artificial illumination was provided in a manner comparable with the supplying of other utilities, looked upon the infant illuminating engineer with much the feeling that we may imagine the pater familias of China contemplating the arrival of a baby girl,—as something wholly superfluous and uncalled for, and the sooner strangled the better.

But things move rapidly in this twentieth century in America. Illuminating engineering has astonished its originators, and confounded its detractors; and in the short space of half a dozen years has arisen to a position of recognized standing and independence, and is today the most talked of branch of scientific specialties. So rapid has been its growth that even a yearly review of its progress is insufficient. S me of the more significant evidences of the development of illuminating engineering in this country within the past six months may therefore be in order. These evidences extend from the Pacific coast to the Atlantic seaboard, and from Seattle to the Gulf of Mexico, and cover every phase of the subject, scientific, practical, and commercial. Improvement of the means of producing light have been marked. The tungsten electric lamp, which has undoubtedly had the most far-reaching effect of any of the recent improvements, has been improved in durability, and has demonstrated its practical value as an every day luminary for the masses. The Nernst lamp has been materially improved, both in efficiency and mechanical detail. A considerable number of flaming arc lamps of both American and European manufacture have been placed upon the market. The mercury vapor lamp has maintained its position as a practical luminary, and progress is reported in the domain of vacuum tube lighting. The so-called "luminous," or "metallic" arc has been likewise improved in construction and its value further demonstrated by actual use. In gas lighting the inverted burner has become an established fact, and its adaptation in the form of the so-called "gas arc" is apparently on the threshold of commercial success; while acetylene has been quietly but none the less assuredly and effectively winning the esteem which its peculiar qualities and adaptability justly merit.

Particularly noteworthy in the field of light production is the fact that every new device for the production of light that has come out within the past year has included an accessory of some sort in the shape of globe or reflector designed to give an efficient and satisfactory distribution and diffusion of its light. The simple fact that the production of light is one thing, and its utilization as illumination is another, is the most elementary principle of illuminating engineering, and the one accordingly upon which illuminating engineers first insisted. Formerly, and that means only a few years ago, the maker of a lamp, whether gas, electric, or what-not, disclaimed any responsibility as to the use made of the light to be produced, and based the value of his apparatus wholly upon the intensity of light which it gave out in some certain direction, using that which would normally be horizontal. Today every improved light-source is sold as a "lighting-unit," and its efficiency given in terms of the illumination which it will produce. Ten years ago a curve of distribution of a light-source was a scientific curiosity, to be found only in rare cases of ultra-scientific papers. A polar curve meant as little to the consumer, and even to the manufacturer, as a map of the canals on Mars.

At the present time no manufacturer would think of turning out a new lighting device without publishing the photometric curves showing its performance.

A more general use and understanding of the several units employed in illuminating engineering has also come about. The term candle-power, which was formerly used on every occasion where it was desired to give an idea of quantity, and which therefore had no definite meaning, has become fairly well understood, and the practically more important term "foot-candle" is no longer considered incomprehensible to the layman.

The electric light and the Welsbach burner marked the beginning of a new era in artificial illumination, making possible an extension in the use of artificial light, and a degree of brilliancy and a variety of artistic and spectacular effects which had never before been possible, or even dreamed of. But progress seems to move by epochs; practically a quarter of a century elapsed during which there was no radical improvement in these new forms of light. Then, as if by a pre-arranged plan, or as if progress in the production of light had been awaiting a due recognition of the importance of its proper use as a science and art, improvements in almost every form of light-source began to appear on every hand. The "flaming" and "metallic arc" in place of the old carbon arc, the Nernst lamp, the tantalum and tungsten incandescent electric lamps, the inverted mantle burner and greatly improved mantles, the mercury vapor arc, and vacuum tube lamps all appeared in such quick succession as to be commercially contemporaneous. Aside from the high efficiency afforded by these various improvements, the multiplications of light-sources, each with its own particular and peculiar advantages, so added to the complication of illumination as to put a thorough knowledge of the subject beyond reach of the average user. The application of the laws of optics to globes and shades, and the scientific treatment of such accessories, added another strictly technical and highly important factor to the subject. The establishment of illuminating engineering therefore fell in at a most auspicious time.

Manufacturers of lighting fixtures, who at the beginning were either indifferent or openly hostile to illuminating engineering, have recently shown unmistakable signs of conversion, and are beginning to wake up to a realization of the fact that illuminating engineering affords the greatest opportunity for their commercial progress that has been presented since gas took the place of candles. The Enos Company, of New York, one of the largest and oldest concerns, and one which has always held a foremost place by reason of the artistic and mechanical excellence of its products, has established an illuminating engineering department in connection with their business. The precedent thus established by a firm of such standing will undoubtedly be followed by similar action on the part of other leading manufacturers, and thence onward all along the line, until all fixture manufacturers of any consequence will work in accordance with the principles of illuminating engineering. Such action will place this already extensive and rapidly increasing trade upon a distinctly higher plane.

Probably the most significant event of all among the numerous indications of progress in illuminating engineering is the recognition which it has recently received at the hands of some of the largest producers of illuminants; foremost among which must be mentioned the Edison Electric Illuminating Company of Boston. While other electricity supply companies have established departments of illuminating engineering, the Boston company has given the matter greater publicity, and thus done more towards its general recognition among the people. It is the first central station, so far as we are aware, to establish an illuminating engineering department in charge of a recognized authority, and to carry out a systematic and extended advertising campaign in the daily press to induce the public to avail themselves of its advantages.

A more extended notice of the educational campaign being carried on by this Company will be found in another section of this issue.

The Denver Gas and Electric Company, which was one of the pioneer companies to make systematic use of illuminating engineering in its own practice, and which has supplied illuminating engineers to

other companies, has recently segregated this department from the other departments of its management, and established a distinct illuminating engineering corps, with Mr. R. G. Gentry, Mr. W. E. Comer, Mr. G. E. Williamson, and Mr. A. W. Hahn as Engineers. Some results of their work are mentioned elsewhere in this number.

The Boston Consolidated Gas Company have announced through the daily press of that city the establishment of an Illuminating Engineering Department, which is placed at the service of its customers. Mr. Wood, the Chief Engineer of the Company, and Mr. Wrightington, the Secretary, are in charge of the department.

Independent illuminating engineers,—that is, those not directly connected with commercial enterprises, both consulting and constructing, are securing substantial recognition in the way of contracts and clients. The Illumination Improvement Company, which is controlled by Mr. Norman Macbeth, who is not only a thoroughly practical illuminating engineer, but has the courage of his convictions, reports such an increase in recent contracts as to necessitate putting on additional working force. Others who have but recently started in business find their hands full.

On every hand evidences are multiplying that illuminating engineering as a distinct science and art is winning its way among the professions at a phenomenally rapid rate.

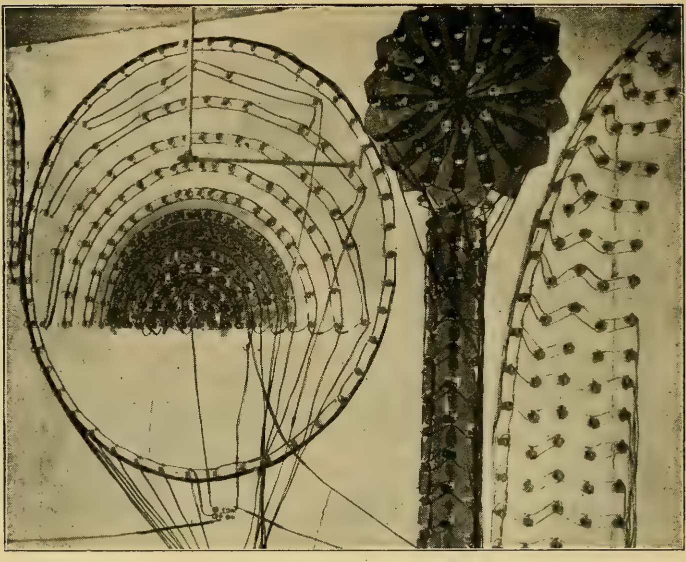
# The Creation of New Sign Ideas

By Egbert Reynolds Dull.

In view of the large number of spectacular, animated, and changeable electric signs, the public may naturally be interested to know where the strictly new ideas come from. The first thing that strikes his eye when he goes down town of an evening, or journeys to another city, is a new electric sign, producing an effect that he never saw before. It may be an animated trade mark advertising a brand of cigars, it may be a glass continuously being filled with whiskey but which never gets full, it may be a weird dragon writhing in front of a chop suey house, or it may be a beautiful fountain, advertising almost anything from spring water to a summer resort. Naturally he wonders who gets them up, how they are produced, and where they come from.

They are created with a machine known as a "flasher," of which there are a great many types. One kind is used for simply flashing a sign on and off, another type is required to spell a sign out one letter at a time, a third is used for producing what is known as "high speed effects"; and then there are a dozen other particular types, each having its individual use. Those which create the most comment are generally known as Combination machines, which as the name indicates, are a combination of several different types of flashers, all mounted on one base, driven by one motor, and so connected with each part does its own work in unison with the rest.

The majority of these new effects come from Chicago. In fact, it is probable that 90% of all the new things seen throughout the country in this line come from one establishment in that city. These new things are conceived, tried out, and perfected in what is known as the "dummy room," the walls of which are known as "dummy boards," a section of one of these boards being shown in the accompanying illustration. In this section will be found a revolving circle, a sun burst, a spiral pyramid, a windmill, and a stream of water. The creation of new effects is as much a process of evolution as it is of originality. One effect suggests another, and while practically the same from the electrical standpoint, it is an entirely different proposition from the standpoint of the layman. Continual experiments on the dummy board to produce an effect often turn out peculiar results. Of course, the ideas are suggested from an unlimited number of sources. When an idea is considered good to experiment with, it is built up on the dummy board according to the way that is considered right. The effect in itself may be a dismal failure, so far as original plans are concerned, and by slightly changing the wiring in some



THE DUMMY BOARD.

cases, you will produce another effect that you didn't think of, that may be as good as, or better than the one you are after. Now you have something new.

But assume that a trade mark is seen on a billboard, that the designer would consider a good subject for an animated sign. He goes to the dummy board, sketches the design out with chalk marks where he wants each socket, and a workman is then sent to screw the sockets in position. He next takes another piece of chalk and marks out every wire in the job just as he wants it to be placed, and the job is wired. He then secures the necessary machine for operating it, turns the current on, and awaits results. Sometimes he will hit it right at the first time, but very often he may have to change the wiring, the machine, the spacing, the size of the lamps, or the colors; but these are simply matters of patience, and he finally gets what he wants.

But he is now viewing his effect at short range, say 25 or 30 feet, to get the same effect that a spectator would a block away from an actual display, so he uses a set of concave mirrors to judge the effect by the image that he sees in these mirrors. Mirrors of different degrees will make the objects appear at different distances away, so that the operator can get the same effect with a 5 foot dummy and a mirror that he could with an actual sign a block away. This also enables him to calculate the different distances apart the lamps should be, the distances that the rows of lamps should be apart, or the effect of different colors, when it is considered that one color will drown out another. All of these things have to be found out on the dummy board.

Assuming that the device is now satisfactory to the operator, he next makes an illustration of it, describes it in detail, furnishes wiring diagram and all information that may be necessary for the sign builder. A few hundred copies of this matter are printed and sent to as many people throughout the country as are interested in this subject, and who are in a position to use it. This list consists of sign builders, central stations, and large corporations who do considerable electric advertising. A particular description may interest one and not another, but if the idea cannot be used as it is sent out, a sign builder may have another customer who can use the same on a similar effect in another way. Then follows a few letters asking for further information, the machine is ordered, the sign is put up and the first the public knows a new spectacular sign is going which he has not seen before, and wonders when the new things will cease.

# Practical Problems in Illuminating Engineering

## An "Automatic" Restaurant

By Norman Macbeth.

In the illumination of restaurants, I have found more positive ideas among owners as to how the installations should be treated than among any other class. This is undoubtedly due to greater experience with installations of the hit-and-miss character (a hit on costs and a miss on results), as restaurant proprietors frequently have many establishments and many changes, having to follow the trade and be convenient to the business centres. Their hours are invariably longer than those in the adjoining stores, with consequently larger costs for light. The business is also such that a careful attention is given to the detail of all costs.

The Horn and Hardart Baking Company, of Philadelphia, were no exception, and in the few lighting mistakes made there was little to charge up to the man on whom many of these charges are placed—the architect. In their larger places arc lamps had been used, until the opening of their third "Automat," at 911 Market St., the first floor of which is shown in Fig. 1. It may be mentioned here that there are no waiters employed on this floor, each patron being his own waiter, aided by the nimble nickel, obtainable in any quantity from the cashier at the door.

At the time this building was being planned they had been convinced that arc lamps were not above criticism. There was always difficulty from the lamp mechanism, carbons would stick, the lamps were constantly flickering, getting out of order and giving trouble, with the result that lamps would have to be cut out for some time, often at a rush hour or busy time, and left until they became cool enough for the trimmer to handle. The main point which had not been considered and which proved to be the final argument, was the physiological effect of the light. The arc lamp being strong in violet-white light gives a cold, forbidding cast to surroundings which should be bright, cheerful and warm appearing. A great many restaurants with arc installations use incandescents also, but the mixture does not improve the general effect. Mixed lighting of this character is bad.

About this time the so-called Holophane arc was being placed on the market, and it was decided to use this unit on the main floor. That these clusters with metallized filament lamps do supply the warm, cheerful appearance desired has been very convincingly proven.

In July, 1907, when the thermometer and humidity combination were bidding for attention, the superintendent was required to make an investigation as to the falling off in business at this location. Being unable to attribute the change to any of the usual causes he observed that many would turn in at the door, stop, and walk out again. The temperature inside was lower than on the street, and the ventilation good, large exhaust fans constantly changing the air in the entire room and other fans being suspended from the ceiling to convey to the customer the idea that the air was kept moving. He finally concluded that the difficulty was due to men-

FIG. I.

tal suggestion arising from the ordinary association of light with heat—"where we have light we have heat, and where it is dark it is invariably cool"; and this place was flooded with light. He had all the 100 watt, 40 candle-power lamps changed to 20 candle-power, and found that the trade picked up immediately. The 40-candle-power lamps were put back in September. This year the change from 40 candle-power to 20 candle-power was made in June, with the change back to 40 candle-power in the last week in August. No falling off in patronage was marked up against this Automat this year, the report showing an ever increasing business.

The data pertaining to the problem of illumination are as follows:—

| | |
|---|---|
| Height of ceiling | 12′ 9″ |
| Height to clusters | 10′ 3″ |
| Height of test plane | 33″ |
| Height of clusters above test plane | 7′ 6″ |
| Number of clusters | 10 |
| Number of 100 watt gem lamps | 40 |
| Wattage per cluster | 400 |
| Total wattage | 4000 |
| Total area of floor sq. ft. | 2156 |
| Watts per sq. ft. | 1.855 |
| Number of test stations | 45 |
| Average foot-candles on plane | 3.04 |
| Lumens per watt | 1.64 |
| Watts per lumen | .61 |

It may be noted from the curves plotted on the floor plan, Fig. 2, that the illumination is fairly uniform, excepting on the line of stations A to O, which give the maximum directly under the clusters, the variation from maximum to minimum on this line varying considerably in photometric values. The minimum, however, is not sufficiently low to make these variations especially observable to the eye, as the general impression is one of brilliancy rather than a lack of uniformity, as might be assumed from the curve.

The following give the results of upwards of two hundred observations with a Sharp-Millar illuminometer, readings being checked by two operators.

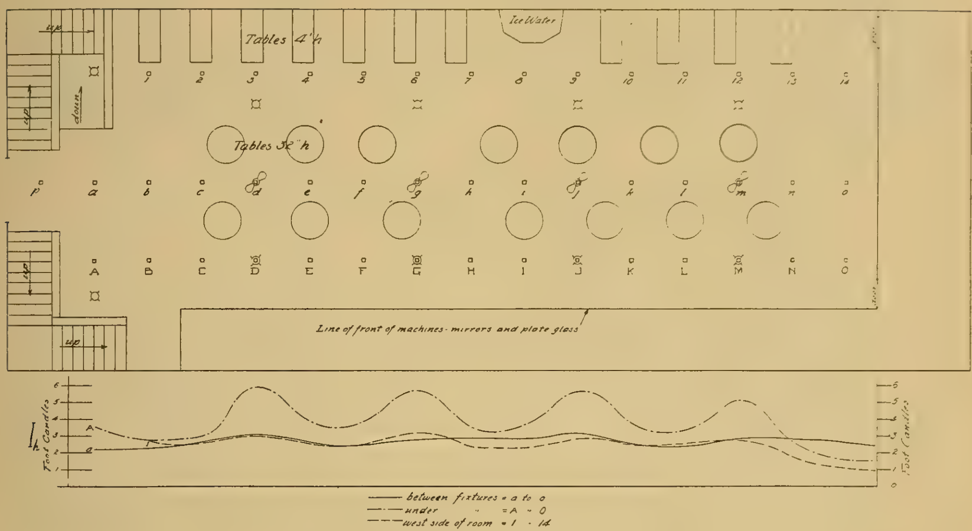



FIG. 2.

## Observed Horizontal Illumination Values.

West Side of Room.

| Sta. | Foot Candles | Sta. | Foot Candles | Sta. | Foot Candles |
|---|---|---|---|---|---|
| 1 | 2.77 | 6 | 3.2 | 11 | 2.53 |
| 2 | 2.56 | 7 | 2.31 | 12 | 2.71 |
| 3 | 2.99 | 8 | 2.27 | 13 | 1.81 |
| 4 | 2.52 | 9 | 2.82 | 14 | 1.08 |
| 5 | 2.48 | 10 | 2.48 | | |

## Center of Room Between Clusters.

| Sta. | Foot Candles | Sta. | Foot Candles | Sta. | Foot Candles |
|---|---|---|---|---|---|
| p | 2.1 | f | 2.49 | l | 2.37 |
| a | 2.19 | g | 2.76 | m | 2.84 |
| b | 2.24 | h | 2.84 | n | 2.84 |
| c | 2.62 | i | 2.8 | o | 2.6 |
| d | 3.06 | j | 3.21 | | |
| e | 2.63 | k | 2.54 | | |

## Under Clusters.

| Sta. | Foot Candles | Sta. | Foot Candles | Sta. | Foot Candles |
|---|---|---|---|---|---|
| A | 3.52 | F | 3.83 | K | 3.73 |
| B | 2.72 | G | 5.72 | L | 3.3 |
| C | 2.97 | H | 3.56 | M | 5.11 |
| D | 5.94 | I | 3.62 | N | 2.71 |
| E | 3.83 | J | 5.62 | O | 1.57 |

The results of this method of illumination have been satisfactory in every way, the place being particularly bright and cheerful, and so pleasing to the firm that within six months of the opening of this Automat orders were given to remove all the arc lamps in the No. 1 Automat on Chestnut Street, and to install the clusters. This cluster, using five 100 watt Gem lamps, effected a reduction of 20% in current costs, also saving the entire cost of the arc lamp maintenance and carbons. The Gem lamps are on a free renewal basis, in accordance with the practice of the Philadelphia Electric Co., who supply the current. The firm report that, in the Chestnut Street Automat, aside from all considerations of cost, the steadiness of the light and the more satisfactory color values have alone repaid them for the change.

## Fixtures and Accessories

# Two-Light Chandeliers

By E. L. Elliott.

In a previous article we discussed some of th difficulties involved in the artistic treatment of a single-light chandelier. Let us now turn our attention to the two-light fixtures, with a view to ascertaining its possibilities and limitations as an object of applied art. To this end we may first consider the theoretical aspects of the case. The mechanical elements which form the basis for the application of art, consist of two light-sources, with a means for their support. The light-sources may be theoretically considered as two points. Now, there are two geometrical propositions involving two points, which have a determining influence in the practical working out of the decorative design, viz: two points determine the position of a straight line; a straight line being commonly defined as "the shortest distance between two points:" and a plane may be passed through any two given points, i. e., two points may always be conceived as lying in a plane. It follows from these two propositions that in the two-light chandelier it is absolutely impossible to get away from either the effect of the straight line, or the plane; and both of these conceptions are wholly devoid of any aesthetic value. In the whole range of lighting fixtures therefore there is none that offers such resistance to artistic effect as the two-light chandelier. The safest course is to avoid it whenever possible.

The inherent difficulties which arise from the mathematical properties just described will be readily appreciated by the study of a few examples.

Fig. 1 shows the mechanical elements of the problem arranged in their simplest form, with a minimum attempt at decoration. The two points represented by the lamps are in each case connected by a mechanical straight line, and this line in turn is connected to its point of support on the ceiling with another straight line. We have here, then, the simplest form of symmetry—one straight line adjoining another at its center. Such symmetry is instantly resolved by the faculties of observation, which precludes any aesthetic feeling. It is this enforced symmetry of the two-light fixture that renders it so difficult a subject to handle. Beauty appeals to the imagination. Art does not consist in establishing a definite fact, but in suggestions which lead the imagination into pleasant paths. That which is at once wholly obvious and fully revealed cannot be truly artistic. Furthermore, the thoughts suggested must be of such a nature as to arouse pleasurable sensations. To illustrate by again referring to

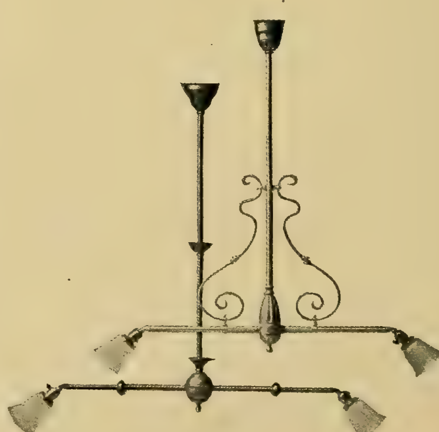


FIG. I.


FIG. 2.

the example: there is, in the first place, almost nothing in the fixtures shown except the bare mechanical necessities. In the simpler of these designs the faint attempts at decoration by way of spiral casings and stampings are not sufficiently differentiated from the actual mechanical necessities to stir the imagination; and even if you insist on exercising your imagination, the suggestions will lead you only to the tube mill and the stamping press, with their clatter of wheels, smell of brass, and begrimed workmen, which will scarcely produce a pleasurable sensation. In the more elaborate fixture the curved braces offer some slight food for the imagination, and to that extent give an artistic touch to the design. The difficulty here is the too apparent fact that they are added on purpose for decoration. The aesthetic instinct is not to be cajolled by coquetry. That which would say, if it could speak, "Am I not beautiful?" would never receive an affirmative answer from the aesthetic sense.

From mechanical necessity a two-light fixture is essentially a plane, defined by the two light-sources and the point of attachment to the ceiling. The appearance of objects in the same plane depends upon the angle at which they are viewed. In illustrating a two-light fixture it will naturally be shown as seen with the plane at right angles to the line of vision. When in use the fixture will be viewed from all angles. It follows that no matter how satisfactory the design may be when viewed at right angles, it must loose its entire identity when viewed from a position within the plane in which it lies, and be distorted to a greater or less extent at all angles except the right angle.

Fig. 2 illustrates this fact. A shows the fixture, which is of pleasing design, viewed at right angles to the plane in which it lies; C is the same fixture viewed within the plane, and B, viewed midway between, i. e., at 45 degrees.

The only real necessity for the construction of a two-light chandelier is where both gas and electric light must be provided. It would seem hardly necessary to call attention to the desirability of maintaining symmetry in the two forms of light-sources in such cases, and yet this simple and obvious direction is not always followed. Figure 3 shows examples of the neglect to follow this principle. The results are so manifestly bad as to require little criticism. In one case the

fixture is wholly out of balance by reason of the single gas burner placed beside the electric lamp, while in the other case the dissymmetry between the imitation candle and the electric lamp shade is aggressively conspicuous.

The general undesirability of a two-light fixture is shown by the fact that few designs showing any particular effort at artistic effect have been produced by American manufacturers. The foreign manufacturer has sought to solve the problem by the use of Art Nouveau motives. Figure 4 shows a simple two-light fixture of this type of design equipped with upright mantle gas burners.

Figures 5 and 6 are designed for use with electric lamps, but could easily be adapted to inverted gas burners.

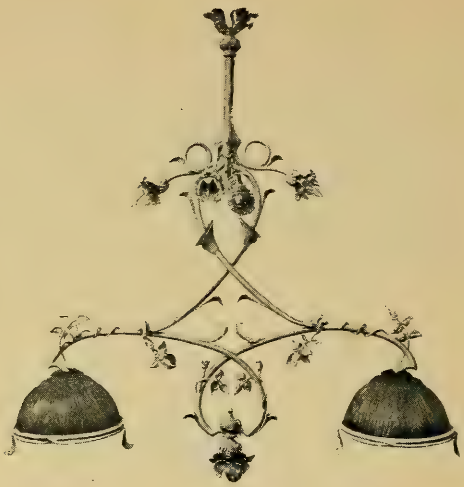


FIG. 5.

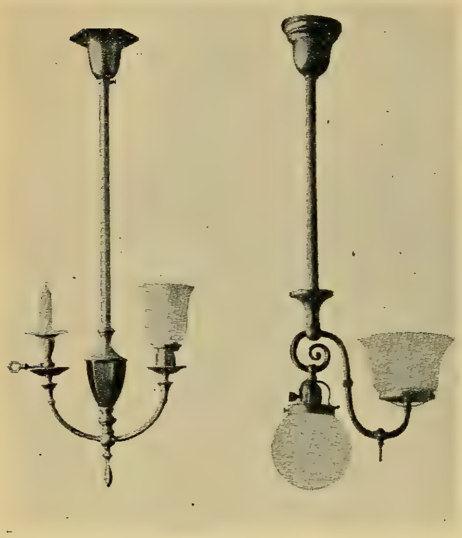


FIG. 3.

FIG. 4.

FIG. 6.

# Theory and Technology

## Calculating the Flux of Light from Various Sources

By Carl Hering.

The illuminating engineer who has to deal with the calculations of the amount of light and illumination, is apparently beginning to appreciate what great assistance it often is in those calculations to determine the amount of flux of light. For the ordinary and the simplest calculation, namely, determining the illumination from the candle power or the reverse, it is not necessary to introduce the flux, but for many other less simple calculations, it often simplifies matters greatly, while in some others the flux must be calculated, as it is the only possible way of getting the result. As an illustration, suppose it is desired to calculate the amount of daylight in a room, so as to find how to light it equally bright at night. The flux here must be determined, as we cannot deal satisfactorily with such an obscure and indefinite quantity as the candle power of daylight, while the flux of daylight is a very real and definitely understood quantity and easy to use in calculations.

There are no methods of measuring flux density; it must be calculated from some other quantity, generally from the candle power. It is generally known that the flux from an ordinary lamp of the usual kind in terms of lumens, (the unit in terms of which flux is measured) is simply 12½ times the mean candle power (more accurately $4\pi$) hence a 16 c. p. lamp radiates 200 lumens. But when it comes to other kinds of lamps or lights, the text books do not tell us how to calculate it. They do not even tell us that it would be quite incorrect to multiply the candle power from any source by 12½ to get the flux in lumens.

The writer has recently calculated what this multiplier is for all the possible typical forms of lights, including such as a window exposed to daylight. It is not necessary to first determine the candle power, but that it was more direct to use the number of foot-candles as determined by the ordinary photometer. Hence to determine the flux from any source, measure the foot-candles of illumination from that source; it should be taken perpendicularly if it is a flat source like a bright wall or a window, and the photometer screen should be reasonably far off so that the source of light may be considered virtually a point. If it is a large window or wall, all but a definite or known portion like a few square feet, may be screened off, in which case of course the flux will be only that through this portion.

From the candle power and distance of the standard lamp from the photometer screen in feet, calculate the illumination on that screen in the well known way, namely, divide the candle power by the number of feet squared. This gives the foot-candles. Measure the distance in feet from the photometer screen to the source which is being measured; if it is a window, then to the middle of the window. The even constants for the different typical forms of lights then are as follows, to which have been added also the values in terms of candles, for those who prefer to use candles instead of illuminating units.

For a lamp radiating equally in all di-

rections:

lumens$=12\frac{1}{2}\times$foot-candles$\times$feet$^2$

lumens$=12\frac{1}{2}\times$candles.

For a very long line, practically indefinite:

lumens per foot$=6\frac{1}{4}\times$foot-candles$\times$feet.

lumens per foot$=6\frac{1}{4}\times$candles$\div$feet.

For a short line:

lumens$=10\times$foot-candles$\times$feet$^2$

lumens$=10\times$candles.

For a very large surface, practically infinite, like the sky, (the distance is not necessary):

lumens per square foot=foot-candles.

lumens per square foot=candles at one foot.

For a small surface:

lumens$=3\times$foot-candles$\times$feet$^2$

lumens$=3\times$candles.

We cannot of course measure a square foot of the sky, but it can be shown that any surface illuminated by the whole sky, has the same illumination falling on it, as would issue from an equal surface of the sky, or of a glass hemisphere covering the object to be illuminated and allowing the sky light to pass through.

If 1 square foot of window photometered ½ foot-candle at a distance of 5 feet, then the flux coming in through that window will be

$3\times\frac{1}{2}\times25=$about 37 lumens.

# Recent Progress in the Voltaic Arc

(CONTINUED.)

By Isidor Ladoff.

Walter Ernest Adeney, in his Letters Patent No. 421,469, dated Feb. 18, 1890, was the first to recommend titanic iron as an addition to a carbon pencil. However, this addition was neither of theoretical nor practical importance, as there was no alloy of titanium and iron known, and titanic iron could not by any means mean titaniferous iron ore. Besides this, the inventor was obviously ignorant of the light-giving properties of titanium, as he mentions the titanic iron along with a long list of substances whose properties are supposed to be infusibility or difficult fusibility, and which otherwise could not affect the luminosity of the arc, favorably or otherwise. All this inventor was after is to increase the durability of the carbon.

In the same category belongs the Letters Patent No. 422,302, dated Feb. 25, 1890, issued to Henry Haswell Head. He also mentions titanic iron in the same unintelligent way as the previous inventor.

Isaiah L. Roberts, in his Letters Patent No. 460,595, dated Oct. 6, 1891, claims a pencil consisting of a metallic shell filled with chromate of iron and hydrate of soda. We mention this patent in view of the fact that a metallic shell was patented previously by Mr. Brush, and that hydrate of soda and potassium was claimed recently by an American inventor as something original. The same Roberts, in a patent dated Oct. 6, 1891, claims a coating of carbon with iron and even iron coated with iron.

John Frederick Sanders, in his Letters Patent No. 496,701, dated May, 1893, claims light-giving metallic salts in connection with a reducing agent and binder. As reducing agent, he claims cyanite of potassium, bicarbonate of soda, phosphoric acid; and as coloring metallic salts the salts of strontium, lithium, indium, calcium, magnesium. He expects to reduce the salts of calcium and magnesium to metal and also add color to the light. He also claims a copper coating and a second coating of an illuminating metal, as magnesium, calcium, antimony and zinc for his electric light carbons.

Jones Walter Aylsworth received Letters Patent No. 553,296, dated Jan. 21, 1896, for incandescent electric conductor composed of refractory metals, among others, titanium.

Henry Blackman invented an electrolytic anode composed of magnetic iron oxide and iron titanium oxide or ilmenite.

Carl Kellner patented incandescent bodies consisting of infusible metals which

are not very good conductors of electricity and which have a high capacity of emitting light with metallic oxides that are infusible or are fusible with difficulty. He mentions titanium among others, titanium nitrate and alloys of such metals, and recommends their oxidation on the surface.

Chas. Rudolph Menges refers to incandescent filaments composed of intimate mixture of a substance having metallic conductivity with a substance not having metallic conductivity. He also mentions titanium and titanium carbide.

Pieper equally claims for incandescent bodies, titanium, titanium nitride and titanium oxide.

It is obvious that the simple fact that titanium or its compounds may be used with advantage in incandescent lighting does not by any means indicate that the same material is suitable for arc light purposes. However, it appears clear that nobody can claim broadly the use of ferric and titanic material, whatever it may mean, as an invention.

## Mineralized Carbons

Casselman investigated thoroughly in 1843, carbons impregnated with various salt solutions, for instance, solutions of nitrate of copper, nitrate of strodium, boric acid, chloride of zinc and common salt. Casselman's observations are summarized in the following table:

| | Carbon Crude | | Carbon With $S_{2-2}$ (NO$_{3-2}$ | | Carbon With KHO | | Carbon With $ZnCl_2$ | | Carbon With No.$_2B_4O_7$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| Length of arc in MM.... | 0.5 | 4.5 | 0.5 | 6.75 | 2.5 | 8.0 | 1.0 | 5.0 | 1.5 | 3. |
| Amperes.................. | 9.1 | 6.5 | 11.5 | 8.4 | 9.7 | 7.9 | 7.7 | 6.4 | 6.9 | 6.1 |
| Light intensity in N. C.. | 9.32 | 1.39 | 3.53 | 2.74 | 1.5 | 7.5 | 6.24 | 1.59 | 11.71 | 1.65 |

The investigation practically coincides in its results with Carree's as seen from the following table.

| | | | |
|---|---|---|---|
| Potash or Soda.................. | Double | 1.25 : 1 | Quick arc Combines |
| Calcium, Magnesium, Strontium.. | " | 1.40 : 1 | Color arc. $SiO_2$ & vaporize |
| Iron, Antomon.................. | " | 1.60 : 1 | |
| Boric Acid...................... | ' | 1.00 : 1 | Increases the life of electrodes. |

Gaudoin pointed out, especially the calcium compounds, namely Calcium, phosphate. The smoke produced by the minerals in the carbon arc was in the way of their general use according to H. Fontain (1877). An English patent 588, issued in 1857, claims the addition of metallic powder to the body of the carbon electrode. The same was claimed by an English patent 2982 in 1887 with the addition of alkaline earths. Archereau, in 1877 suggested the addition of magnesia. Carre introduced first boric acid into carbon electrodes, which did not hinder P. Stiens of London to receive a patent (Germany 85592, April 11) in 1895. This patent was later on, modified in the patent 98210 of Sept. 25th, 1896 (Germany), recommending the use of organic compounds containing Boron and oxygen, as for instance Bo(OcH$_3$) and Bo(Oc$_2$H$_5$)$_3$. A. Edelman of Charlottenburg recommended the addition of Borontrocalcik to the carbon electrode. Friedrich Krupp, of Essen in 1893 (German patent of Sept 1st) claimed to increase the life of the carbon electrode by the adition of Tungstic acid or its salts. Acheson claimed (Russ. Priv. 1731 of 1896) a combination of 90 per cent. carbon with 10 per cent Silicon for a carbon electrode. In the U. S. Patent 568323 he claims to create carbides in the carbon pencils by such addition, which in their turn produce graphite. Fussner in 1889 impregnated carbons with salt solution of alkalies and alkaline earths. Strangely enough, Fussner claimed in direct contradiction to Carre, that the addition of such salts, for instance common salt and potash cuts down to a half the quantity of light given by the pencils. This did not discourage other inventors from claiming impregnations with other solutions. A German patent 30042 of June 1, 1884, and 47490 of May 12, 1888, recommended for the carbon pencils a bath of calcium-chloride solution and other solutions of alkaline earth. The German patents 65735 of May 22, 1891, and 72444 of July 24, 1892, recom-

mend an impregnation with sulphates, phosphates, chlorides, phosphoric acid, etc. Brush (U. S. Patent 10544) used borax and waterglass, while Roubel (French patent 251603 of 1895 and German patent 58977, May 28, 1896) claims a combination of graphite and waterglass. A. Heil (German patent 98625 of June 9, 1897) treats the carbons preliminarily with Ammoniak, impregnates them subsequently with potassium hydrate and finally coats them with paraffine.

There is a number of patents covering cored carbon pencils.

Repieff (English patent 4432, 1877); J. Roubel, Meyer (German patent 98875 of Jan. 23, 1898) impregnated the mantles of the carbons with materials calculated to increase the light efficiency. Singer proposed to surround the carbons with a mantle of cement (German patent 105282 of 1898). Par Mersch (German patent 110739 of Apr. 28, 1898) surrounded the carbon pencils with a composition of alumina-silicates.

Metallic mantles, tubes, or containers were especilly favored by American inventors. The first mention is Brush, who used nickel and copper. Many others claimed later, iron and other metals. H. W. Wiley even proposed to surround the metallic tube with plaster of Paris in 1879. All kinds of substances were proposed as additions to cores. MacManus (U. S. Patent 504815) adds iron to the carbon and uses a core of lime. Roberts (U. S. Patent 562030) describes a core composed of carbon and chromate of potassium. J. F. Sanders (U. S. Patent 649551) adds to the mass of the carbon oxides or phosphates of copper, or magnesium, using as a core carbon saturated with soluble alkali phosphates. Acheson proposed his pet Carborundum as a material for coring. Nienwerth in 1894 protected carbons containing flame coloring matter in their cores. Suthman (German patent 105283 of Oct. 31, 1898) and Weston (U. S. Patent 210830) recommends an eccentric arrangement of the core so as to form a single crater point for carbons meeting at an angle. The same suggestion is contained in the patent application of Siemens Bros., dated Apr., 1879. For the manufacture of cored carbons three methods were proposed:

1. The separate parts to be manufactured separately and then joined together into one elctrode—was the first method.

II. The second method consisted in preparing the mantle and filling it subsequently with coring material.

III. The third method was to surround the ready made core with a mantle after the manner of a lead sheath surrounding a cable.

IV. The fourth method proposed to prepare the entire pencil in one operation by a specially designed press.

H. F. Labiron protected a device (German patent 81386 of Sept. 29, 1894) for a composite carbon pencil each part of which was prepared separately. I. A. Deuster of Boston (German patent 93882 of Sept. 22, 1896) even proposed a pencil of which the two parts were interchangeable. The second method is the only one used extensively in the manufacture of cored electrodes. Pritchard was the first to describe in 1890 a core press. The German patent 86776 of July 26, 1894, protects a hand coring press. The German patent 94791 of December 21, 1896, monopolized a design for an automatic core press. A German patent 21511 of August 12,1881, describes a complex carbon press with concentric plungers for the manufacture of cored pencils according to method IV. (See full description of presses in "Die Kuenstlichen Kohlern, Berlin, Springer, 1903 pp. 215-224).

In 1900 H. Bremer of Manheim, Germany, exhibited at the World's Fair in Paris, his highly efficient orange colored arc lamp. Prof. Wedding examined the lamp and found that it gave an average efficiency of 0.1 watts per candle, an efficiency never atained so far by any electric lamp. It produced a sensation similar to that of Jablochkoff's candle and seemed to open a new era in electric illumination.

German patent 118464 of June 27, 1899, isued to Bremer, claims carbons containing at least 5 per cent. fluorine or bromine salts together with Calcium, Magnesium, and other metallic salts. Besides these other chemicals for quieting the arc are mentioned, namely salts of boron, potassium and sodium. A coat of waterglass was also recommended. Another German patent, 127333 of July 25, 1899, recommends a mantle of Calcium, Magnesium or Alumina containing materials.

*(To be Continued.)*


## The Second Annual Convention of the Illuminating Engineering Society

Two and a quarter centuries ago, there was founded in the wilderness of America a city, to be called Philadelphia. The week beginning on the fifth of October has been set aside by the municipal authorities of this city of "Brotherly Love" as a season of celebration in memory of its founding. Something over two and a quarter years ago, there was founded in the neighboring city of New York an association known as the Illuminating Engineering Society; and the fifth and sixth days of October have been chosen as a time for a general "gathering of the clans" that now constitute this national organization, and the place of meeting—Philadelphia.

There is much material for retrospection in this meeting of the youngest of the scientific organizations in one of the oldest of our cities. When Franklin set up his printing press in Philadelphia, and proceeded to start the publication of a newspaper, head-shakings and predictions of failure were not wanting. There were already two newspapers published in America, and the wisdom of starting another was questionable. America has grown some since that time, although, as compared with the ages that have passed in the rise and fall of other nations, this period is but a mere trifle. Gathering momentum from all the experience and knowledge of these previous ages, progress has advanced at a rate of acceleration that was inconceivable to those who went before. Since Franklin's time many a newspaper and magazine have found a place among American readers; and the end is not yet.

When a handful of those who had been particularly interested in the subject of lighting came together some three years ago, and discussed the feasibility of establishing an association of national scope, there was the same head-shaking and direful predictions that met Franklin's venture. Was there not already the Institute of Electrical Engineers, and the numerous local gas associations? And as one of the veteran electrical engineers said, "Why should there be an association of illuminating engineers any more than an association of armature winders?" But the association was formed; and in view of its history up to the present time, the objections to its foundation and the predictions of failure seems scarcely less absurd than those launched at Franklin for his timerity in starting a third newspaper in America. It is perahps as difficult to obtain a vision of the future by those standing in the present today, as it was a century ago.

In selecting Philadelphia as the place of meeting, and its celebration week as the time, the Society has followed the precedent established last year, when it met during "Old Home Week" in Boston. The double attraction should draw a large attendance, as was the case last year. A well diversified and comprehensive program of papers has been prepared, as will be seen by inspecting the following list:—

President's Address ........Dr. Louis Bell

Architecture and Illumination..........
....By Mr. Emil G. Perrot, Philadelphia

Modern Gas Lighting Conveniences....
....By Mr. T. J. Litle, Jr., Philadelphia

Railway Car Lighting ................
....By Mr. H. M. Davies, Philadelphia

Relation between Candle Power, Voltage and Watts of Different Types of Incandescent Lamps ................
..By Dr. F. E. Cady, Washington, D. C.

Illuminating Value of Petroleum Oil....
........By Dr. A. H. Elliott, New York

Structural Difficulties in Installation Work....By Mr. J. R. Strong, New York

Street Lighting Fixtures, Gas and Electric ................................
..By Mr. H. Thurston Owens, New York

Oil Burners...........................
.......By Mr. W. T. Sterling, New York

Design of the Illumination of the New York City Carnegie Library..........
..........By Mr. L. B. Marks, New York

Intensity of Natural Illumination Throughout the Day.................
......By Mr. L. J. Lewinson, New York

Calculation of Illumination by Flux of Light Method..By Messrs. J. R. Cravath, Chicago, and V. R. Lansingh, New York

Specific Intensity of Lighting Sources..
....By Mr. J. E. Woodwell, Washington

Design of Reflectors for Uniform Illumination .............................
.....By Mr. A. A. Wohlauer, New York

The Ives Colorimeter in Illuminating Engineer ..........................
....By Dr. H. E. Ives, Washington, D. C.

International Unit of Light.............
..By Dr. E. P. Hyde, Washington, D. C.

Some Experiments on Reflections from Walls, Ceilings and Floors...........
..By Messrs. V. R. Lansingh and T. W. Rolph, New York

The meetings will be held in the Hotel Walton, which is very centrally located, and will give the added convenience of allowing the visiting members an opportunity of living at the same location. The rates for rooms are from $2.50 to $5.00 per day.

It is needless to urge any reasons why every member, and every one else interested in the subject of artificial illumination, should attend this convention. We understand the papers will be read in abstract, so as to give as much time as possible to their discussion, and this should prove the most valuable feature of the meeting. Formal papers can be printed and circulated among the members, but the exchange of ideas by personal discussion can only take place at such a meeting as this. We can therefore only say: **"Come to the Convention, and come prepared to talk."**

## To Fixture Manufacturers and Dealers: Get Together!

The secret of success of the American manufacturer is comprehended in a single word—organization. This applies to the individual organization of each manufacturing concern, and the general organization of all the different concerns in one line of business in the form of national associations.

The advantages of trade organizations are many and beyond dispute. Their general purpose is to regulate competition. Competition is a good thing within certain limits, but it contains a destructive element; it may easily degenerate into a sort of gorilla warfare, which only serves to exhaust the resources of all parties to the conflict, and make itself a nuisance to those not directly involved. The only safeguard against such a condition of affairs is for the competing parties to get together and form an association for their mutual protection and advancement. The ideal condition of business is not unrestrained competition, but rather of emulation. There is this difference between competition and emulation; the former strives to secure what may go to another by every means possible, while the latter consists in an effort to surpass others in excellence and quality. Emulation, which is the result of properly regulated competition, is a condition to be desired by both the producer and the purchaser.

The manufacture and sale of lighting fixtures in this country is an extensive and important branch of industry, and it is a remarkable fact that at the present time it possesses no general trade organization. As a result there is a great deal of working at cross purposes, and a constant dissipation of energy and money that might be better conserved in promoting the general welfare of the trade. Gorilla tactics are too much in evidence. The sooner all parties "get together" and direct their energies toward the general uplifting and advancement of their common interests, the better it will be for their commercial prosperity.

Let it be frankly admitted that the expectation of financial gain is the one leading motive of all those connected with industry in any way. Profit is the heart of business, if not the soul, and suspended animation cannot continue for long in any case. The vital question then, is how to get the most money out of the business with the greatest amount of general satis-

faction, and the least amount of mental wear and tear.

One of the largest items of expense in any business is the getting of it. Not infrequently this item exceeds the actual first cost of the manufacture of goods—in the establishing of a new business this is always the case. There is a certain amount of fixture business to be had in this country; barring a small amount of importations, this business must of necessity be distributed among the American manufacturers. The total profits that will accrue will be largely determined, as just stated, by the deductions made for expenses of getting this business. In the present unorganized condition of the fixture trade, with the resulting unguided competition, must it not necessarily follow that the amount expended for getting this business is vastly larger than it need be?

Just how this could best be accomplished is a matter to be worked out by the association itself; but that a large total saving in this item might be effected by mutual co-operation seems beyond dispute, if the experience of other similar organizations counts for anything.

The enormous annual expenditure of the fixture manufacturers in the preparation of "competitive" designs is another item which cuts a very considerable figure when the profits of the year's business are figured up. As was pointed out in a previous article, many of these competitions are mere bluffs, the winner having been picked in advance. Concerted action should be able to greatly reduce the evils that now result from this system.

The piracy in the use of designs, which is so bitterly complained of at the present time, is another evil which could be reduced to a minimum, if not wholly suppressed, by a strong active national association.

Another evil, against which illuminating engineers as well as fixture manufacturers have often inveighed, is the relegation of the lighting installation of buildings entirely to the rear by architects. The ill effects of this practice are numerous. The outlets from which the illuminant is supplied are often so badly arranged that an efficient and satisfactory illuminating system is well nigh impossible, and the original estimate of the cost of the building being often entirely used up or exceeded by the time the fixture contract is arrived at, the expenditure for fixtures is shaved down to the lowest possible limit. As a result, fixtures of inferior design and construction are the only kind that can be purchased. Active co-operation will surely go a long way toward mending this unfortunate condition.

Lastly, much could be done by such an organization toward educating the public to the appreciation of better art and better illuminating engineering practice. It is hard to conceive of a fixture manufacturer or dealer who would not prefer to handle fixtures that are good both in design and workmanship; but from the tyranny of demand there is not escape except by public education.

Why not follow the example of the other lines of industry, and get together?

## Let Us Have the Stores Open Evenings

Beginning with the most "exclusive" class of dry-goods stores in the largest cities, and gradually extending to other classes of stores and smaller cities, the practice of closing at 6 o'clock has become general. The exceptions are small country villages and the stores in the tenement districts of the cities. Even five o'clock closing and the Saturday half-holiday during July and August are by no means uncommon.

Does this system work out the greatest good to the greatest number? We believe not.

The customers constitute the greatest number; and it is they who furnish the merchant his profits, and whose money pays the salaries of the salespeople. The welfare of the customer is therefore paramount. By far the larger portion of the customers are women. Now a woman's work is normally such that she can not conveniently leave it during the forenoon. As a consequence the stores are congested to such an extent that trading becomes a severe tax upon the patience and endurance of both buyer and seller during the few hours of the afternoon. The woman at home must either subject herself to this annoyance, often with the added discomfort of a ride home in a street car loaded

to the ground with laborers of every description, or must disarrange her regular household routine in order to shop during the forenoon.

But the working woman or girl fares still worse; she has no time at all in which to shop without taking her lunch hour, or getting a half day off. Furthermore, the afternoon shopper adds to the crush of the street car traffic at its busiest hour, thus aggravating a condition that is bad enough at the best.

Why should not the evening, which is the leisure time of all classes of people, be available for shopping? In the old days of oil lamps and gas flames the impossibility of lighting the stores so as to properly show the goods furnished a strong reason for night closing; but with modern illumination there is no more reason for restricting trade to the daylight hours than there would be in conforming theatres to matinees. If stores were kept open until 10 o'clock more than half the trading would be done in the evening.

But what of the salespeople? Should they have to work fourteen hours a day? By no means. Let the stores open at noon; this would give the entire forenoon for arranging and marking goods, and replenishing stocks—work that now is done at night. From noon to ten P. M. is only ten hours, the same as the present arrangement of 8 A. M. to 6 P. M. But the former is divided equally, on the average between day and evening, thus affording equal opportunity to those who, from convenience or choice, would select either day or evening for this shopping. Everybody would be accommodated. It is altogether probable that a larger total volume of trade would result from this arrangement. The convenience of being able to use the leisure evening hours would surely result in their being used to a greater extent, just as the convenience of the penny-in-the slot vender creates trade in the commodities offered. Let us have the stores open when we all have time to visit them. Why not have shopping a pleasure instead of the nuisance that it is under the present arrangement?

## The Latest Suggestion for a Primary Photometric Standard

The measurement of the several physiological effects of light constitutes the science of photometry. As in all other cases of the measurement of natural phenomena, one primary unit must be chosen, from which such other units as may be necessary or desirable may be derived. The science of photometry differs from all other branches of the general science of mensuration in the fact that the thing that it is desired to measure is a physiological effect, commonly known as vision. The matter is still further complicated by the fact that the physical cause of this sensation is itself of a complex nature. The physical thing which we call light, and which produces the sensation of vision, is a compound of a very considerable degree of complexity in its make-up. It may be compared, for analogy, to a single sound produced by the concordance of a great number of notes of different pitch: the general effect, or quality, of the resulting tone will depend upon the relative loudness of the different tones of which it is made up. In a similar manner, the effect of light upon the eye depends upon the proportion and relative intensities of the different kinds of rays which enter into its composition. If you were required to determine by the sense of hearing when two sounds of entirely different quality (such for example as the note from a bell and a note from an organ pipe) were of the same intensity, or loudness, you would at once appreciate the difficulty of determining equality between sensations resulting from such different combinations of causes.

The same difficulty arises in attempts to judge the equality of two lights in point of intensity, or brightness, which differ in their composition or color.

The ultimate basis of all measurements is to be found in some one of the six senses. In every case the unit, or standard, is obtained by fixing upon some physical quantity which shall be as nearly as possible invariable and reproducable; and this method has been followed in the case of photometry. In attempting to provide a unit, one physiological effect has been taken as a basis; namely, the intensity or brightness of a white surface. A unit based upon this method depends upon a source of light which will always give out rays of the same intensity in some particular direction. This sounds like a simple proposition, but it has offered more

obstacles to a satisfactory solution than any other single problem in the whole science of mensuration. Light in itself as a physical entity is an exceedingly delicate and abstruse phenomenon, and in its artificial production is subject to such extremely delicate influences and conditions as to render any attempts at its uniform production next to impossible. The simplest form of all light-sources was the first to be used as a standard, and strangely enough, is still used to some extent. This is the common candle, which has fixed its name apparently beyond hope of change upon all primary standards of light used in English speaking countries.

The theoretically perfect standard, or unit of measurement, is one which can be reproduced independently at any time, and which, when so reproduced, will always be of the same absolute value. Of all the fundamental quantities time is the only one which has a theoretically perfect unit. The most careful researches by the greatest scientists of the ages have failed to produce a practical primary standard of either of the other fundamental quantities,—length and mass, which conforms to the theoretical requirements. The actual primary standards of both of these quantities are to-day entirely arbitrary, and if lost, could only be reproduced approximately from the best copies remaining. Although less accurate than the other standards, the standards of light that have been proposed and used have all possessed the quality of being independently reproduceable. With a single exception, all primary standards of light that have been found serviceable have been flames, produced under very carefully prescribed conditions. The single exception is the standard proposed by Violle, which consists of a square centimeter of molten platinum at the moment of solidification. This latter standard was theoretically very promising, but failed in practice.

The incandescent electric lamp has provided a secondary standard of great exactness and utility, and has been the means of reducing photometry to a reasonably exact and commercially practical science. Measuring instruments have a genealogy similar to that of living beings. Thus, every yard stick is distantly related to that particular metal bar kept by the Department of Standards in London, the distance between two cross markings on which is the yard; but to trace the genealogy of a yard stick picked up at random to this original parent of the race of yard sticks, would be as hopeless as to attempt to trace one's family back to Adam. It is simply a case of a copy of a copy ad infinitum; and yet for all this copying, the discrepancy between the ordinary yard stick and the primary standard is of no practical importance. The incandescent electric lamp offers a similar solution of the problem of a standard for the measurement of light. It is a comparatively simple matter to produce an electric lamp which under conditions are sufficiently easy to maintain, a lamp differing from a given lamp by an amount so small that it may be neglected. Similarly, copies of this copy may be made, and thus the tribe of standard lamps multiplied to any desired extent. With sufficient care the last copy will be practically the same as the original standard. So, just as the standard bar in London, though it may not be actually used for comparison and for copying once a year, still serves its purpose as a standard, it is entirely feasible that a single incandescent electric lamp should be chosen as a standard and kept equally safe, which with a corresponding amount of use, would last for at least a century. The theoretical problem however, of producing a standard is always an attractive one for the student of pure science, and we shall therefore probably continue to have from time to time new methods suggested for producing a standard of light.

The latest suggestion of this kind comes from Dr. Steinmetz, and is set forth in a paper presented at the last Convention of the American Institute of Electrical Engineers. The chief point of difference between the standard proposed by Dr. Steinmetz and all standards heretofore used is that it consists in a method of resolving what we commonly know as white light into three constituents, producing these three different constituents by a method that shall insure uniformity, and combining the results to produce the standard light. He accepts the "three color theory," the advantage of which has been practically demonstrated in many commercial processes:—such for example as three color printing, and proposes to

produce red, yellow and green rays of definite intensities, and by combining these, secure a unit which shall be not only constant and definite in intensity or brightness, but also in composition. All three of these colors can be produced under conditions that are not impossible to obtain, by the use of an electric current and mercury vapor.

The suggestion is a most interesting one from the theoretical standpoint. The question arises, is it practical? If the working, or secondary standard of light which is almost universally used at the present time, namely, the incandescent electric lamp, were lost or broken, would it be replaced by comparing another lamp with the combined light produced from three mercury tubes in accordance with Dr. Steinmetz's suggestion, or would a copy of some other standardized incandescent lamp be obtained? Theoretically the standard of length can be obtained from a pendulum having a given rate of vibration; but it is freely admitted by scientists that if the standard bar were actually lost or destroyed, some one of the immediate copies would afford a more accurate means of reproducing it than a resort to the theoretical pendulum. It seems to us that the same would hold true in the case of such a theoretical standard of light as Dr. Steinmetz suggests. All serious attempts, however, to arrive at greater accuracy in the measurement of light are to be encouraged, and given most careful consideration and experimentation by those who have the facilities and the time. Doubtless the suggestion made by Dr. Steinmetz will be taken up by other competent investigators and its practicability or impracticability demonstrated.

## A Comedy of Errors

If a hundredth part of the typographical errors which have produced meanings that were entirely apart from what the writers had in mind could be collected into a single volume, it would make Shakespeare's famous comedy seem prosy in comparison. Usually the typographical mistake bears the evidence of its error so plainly upon its face that no particular harm is done. It is possible, however, for an exceedingly small mistake to entirely change the meaning intended. For example, in the August issue we discussed the rather remarkable fact that so important a branch of industry as the manufacture and sale of lighting fixtures is without a national organization. When the edition came from the press we were dumbfounded to find the following statement: "It is most reasonable to suppose that this industry has attracted to it only commercial pirates and shysters." The statement is so badly false as to be truly humorous. But supply the little prefix "un" to the word reasonable, and we have the following perfectly sane statement, which was the one intended: "It is most unreasonable to suppose that this industry has attracted to it only commercial pirates and shysters"

## The Illuminating Engineer as an Architectural Critic

Mr. Bassett Jones, Jr., discusses the above topic in the Electrical Review of September 12th, as follows:

"If the illuminating engineer criticized lighting fixtures only, and only as fulfilling or not fulfilling engineering requirements, the architect would have not complaint to make. But the engineer as engineer has been emphatic in his opinion as to the artistic value of many lighting installations, and, not satisfied with this, he has extended his criticisms to architectural treatment in general."

However much we may respect and admire Mr. Jones' opinions on art, architecture, and illumination, we cannot agree with him that the illuminating engineer is, by virtue of his profession, debarred from architectural criticism. When the illuminating engineer criticizes the architectural features of a building he does so, not as an engineer, but as a layman, and is not only entirely within his rights, but, on general principles, is a more competent critic than the architect. Buildings are not put up for the use of architects, and it is really of little consequence what architects think of them. Whether the drama, the poem, the novel, the painting, or the building, is or is not worthy of commendation is decided by those who know little or nothing of the technology connected with their production. By taking up the profession of illuminating engineering a man by no means abdicates his right to express his personal like or dislike of any work of art or artisanship.

# Correspondence

## From Our London Correspondent

It has been very apparent to those who study the different shapes, forms and designs of incandescent gas burners that those of the inverted type, which have the bunsen tube surrounded with magnesia, asbestos, china or other protective and heat retaining material, secure a very much more brilliant light; in fact, not only is the mantle incandescent, but also the material within the mantle. Further, the material radiates considerable heat. This leads us to draw attention to a single device, illustrated Fig. 1 for the purpose of increasing the efficiency of the ordinary upright or Kern burner. The addition shown can be made in another form and used in connection with the inverted burner. The invention consists of a solid cone-shaped body of steatite clay, circular in section and of special proportions, which have been determined in order to secure certain effects; the largest or bulbous part being at the base, with the upper part tapering off. After many experiments, the inventors, Messrs. Eady and Mr. Joseph Cash, have found it to be the most effective form for primarily intensifying the incandescence of the mantle. The conical body is passed on to the crutch, or prays which carries the mantle, the under side is so shaped that when seated on the cap of the burner, as shown, it offers no check to the combustion of the gas. The introduction of this steatite cone obviously affects both flame temperature and the volume of flame brought into contact with the mantle. As the annular space within the mantle is reduced, the travel of the flame over the surface of the mantle is increased in velocity, and has a self-intensifying action, almost at once after lighting up the cone becomes heated up to a white temperature, and gives a most brilliant illumination.

FIG. I.

A series of tests made with a Kern burner and mantle without the cone, using 4 cu. feet of 15.50 candle gas gave an average result of 63 candles. Using the same burner with the cone the average of a number of readings was 76 candles. Another set of tests made with a No. 4 Kern burner and mantle showed an average of 58 candles without the cone and with the average of the readings was 81 candles, the consumption of gas being maintained at 4.2 cu. ft.

Street lamps fitted up with the ordinary burner and mantle gave 43 candles, but when using the cone the illuminating power was increased to 67 candles; these tests were made in situ with a portable photometer.

Our next illustration (Fig. 2) shows a

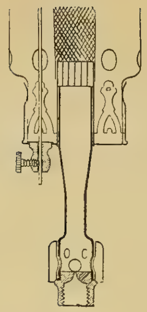


FIG. 2

recent improvement in the Meker burner which was first exhibited at a meeting of the Societe Technique du Gaz en France, in 1905. Since that date the burner has been much improved, and at the congress of the Society, quite recently held in Paris, the inventor stated that some alterations had been made in the mixing tube and the dust protector. The burners are made in three sizes for consumptions of

| | | |
|---|---|---|
| 50 | 80 | 100 litres |
| 1.75 | 2.8 | 3.5 cu. ft. |

With the original burners the consumption of gas varied from 11 (0.37 cu. ft.) to 13 litres (0.46 cu. ft.) per carcel hour—9.6 candles with the modified burner the gas used to produce the same candle power is reduced as follows:—

| | | |
|---|---|---|
| 8.5 | 9.5 | 10.00 litres. |
| 0.30 | 0.335 | 0.353 cu. ft |

The economy effected by the new burner is quite 20 per cent. This burner is extensively used in France for testing purposes.

Although the advances made in connection with the strengthening and toughening of the incandescent mantle have been very surprising, they are, and of necessity always will be most friable and delicate, therefore it is not to be wondered that inventors are still busy with what are called anti-vibrators. In Fig. 3 we give an illustration of an invention to be applied to incandescent burners of the type in which the bunsen tube is fixed and the support for the mantle is suspended with the object of preventing vibration. Such burners usually have the bunsen tube attached to the gas supply pipe or other fitting the upper part, or mouth being more or less cylindrical or bell shaped so as to fit over the top of the bunsen tube, the joint being as tight as is consistent

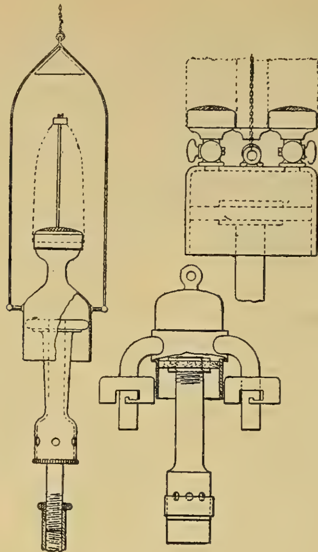


FIG. 3

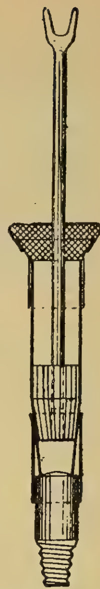


FIG. 4.

with freedom of movement between the interior of the bell and the part of the bunsen tube fitting therein. In the invention under review, the bell is freely suspended by a bridle and chain, or other suitable and flexible connection, combined with this method of suspension is an asbestos packing ring which does not expand under heat, will work well as a piston and be of a shock-absorbing nature. When more than one burner is used, the bell is suspended from the highest central point by a chain, link or other flexible connection.

When provided as a fitting for an inverted burner, the burners are made in the form of a curved or bent and downward projecting tube provided with mantle supports equidistant from each other, while the bell is supported at the top as before. In order to regulate the position or height of the flame at the top of the bunsen tube, in the bell, and to facilitate the removal of the bunsen tube for cleaning purposes, the lower end is connected to the gas fitting by a nose piece or nipple with a large screw; this permits of the removal of the bunsen tube with the minimum amount of movement being communicated to the bell.

The illustrations show, first a view of an upright burner, second an elevation of a cluster of upright burners, and third, a cluster burner of the inverted type.

This arrangement is the invention of Mr. F. Turner and Mr. G. Hands. The latter gentleman will be remembered as the joint inventor of the Norwich switch for automatically lighting and extinguishing gas burners from a distance which we fully described in this magazine.

Possibly it may be news to some illuminating engineers that under the Patent and Designs Act of 1907, which comes into force at the end of August, all persons who have taken out patents and thereby secured protection for their rights in an invention under the British patent laws, will be compelled to manufacture in this country. This condition has been obtained in America for many years and goods manufactured under patents secured in America have to be manufactured in that country, and the same article made under the English patent is not permitted to enter into competition with the same article in America. Very many gas burners and fittings have, however, for years past been made in Germany under British patents and sent over to this country competing against British made goods and too often being sold at a lower price, to such an extent that the original owners of the patent have been compelled to cease manufacture. The new act will change all this and the foreigner will have to manufacture in Great Britain if he desires to sell his goods to purchasers in this country. Already many German firms are starting factories in order to carry on the manufacture of such articles as they have been in the habit of supplying to customers here. It has been computed that this new law will result in an immediate investment of large sums of money in this country for the establishment of factories and in addition will ensure the payment and circulation of an enormous sum in the payment of wages and the purchase of raw material.

A patent has been granted to Mr. S. Halman for an invention to provide a burner in which a suitable admixture of gas is secured so that the mixture, though weak, will ignite and burn steadily without the possibility of firing back. Fig. 4 shows the general application; on the end of the burner proper is a tube tapered at one end and connected to the burner by a sleeve; within this tube is a plug, tapered at one end which is provided upon its periphery with a number of longitudinal recesses, preferable V shaped in section, these diminish in cross section from the larger to the smaller end of the plug. Thus, when the plug is fitted the gas issuing from the burner proper is caused to pass through first, the reduced portions of the V shaped recesses so that the pressure is considerably reduced; while upon the plug being inverted the gas is not caused to pass through the reduced portions of the longitudinal recesses, and the pressure of the gas is increased. This plug serves at the same time for the reception of the mantle carrier or "crutch." There is fixed on the outlet of the burner a wire gauze cap which serves as a mixing or expansion chamber for the air and gas, the top face is concave in form so that the outcoming gas may be evenly distributed. It is made in two parts, one cylindrical, the upper extremity being enlarged or flared outwards, and a circular covering, the edge of which is bent over so as to lie outside the flared extremity. These details will easily be followed by a reference to Fig. 4.

There is considerable discussion over here on the question of automatic and manual lighting of street lamps; the authorities "hasten slowly" to adopt automatic lighting and extinguishing. Sir George Livesy recently addressed a communication to a leading journal connected in the local authorities and said: "From time to time there have been notices of automatic lighting of public gas lamps, but the important question of displacing labor and thereby increasing the number of the unemployed has not had much consideration by the proposers of the system. In one case that came under my notice the main part of the estimated saving was in a considerable shortening of the hours of lighting, the lamps were in my opinion to be lighted too late and put out much too early—1¾ hours before sunrise. Apart from this the saving would have been immaterial."

The reply of the gas company to the question as to the reduction in their charge was to ask the borough council whether they had considered the question of the displacing of a number of lamplighters, who would be deprived of work,

and who would add to the number of the unemployed. Nothing further has been heard upon the subject. Sir George Livesy is the workingman's friend, and those fortunate enough to be in the employ of the South Metropolitan Gas Company, of which he is chairman, or as you in America would call him, President, are considered in every possible way. But in these days the wants and claims of the public must have the first consideration. A lamplighter has a certain district and a considerable number of lamps to light which take him, say two hours or probably more, the result naturally is that the first lamp must be lighted too soon and the last lamp too late. This is bad economy, and in a time when invention has produced means for automatic, and instantaneous lighting of a whole district at any given hour, it is absurd to argue against the system. The saving of gas consumption, per lamp, is very considerable, and the cost of labor practically nil. It is true that the cost of installing the special apparatus is at present somewhat expensive, but the initial cost is soon covered by the saving already mentioned. One of the great advantages of electric lighting is that the illumination is only supplied at the moment it is needed, and then without the aid of a perambulating lamplighter. Gas lighting can now be carried on almost as quickly and the day is not far distant when the occupation of the lamplighter will be gone—just as the driver of the old four-wheeled cab has passed away through the advent of the smart and up-to-date taximeter motor cab. Inventions make these changes possible and the public demand their adoption.

We have in these columns already called attention to dust traps for the protection of incandescent burners; we have before us particulars of a gas adjuster and Dust trap, the invention of Mr. Philip Winn. The gas is regulated by raising and lowering a block "d," shown in illustration in Fig. 5, by means of a small screw "g," a hood "e" on the upper end of the block directs the dust and grit into the annular space. The illustrations, Figs. 5 and 6 show the regulator, or adjuster closed and open.

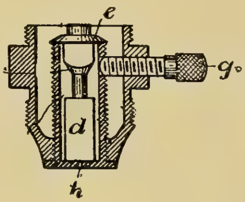



FIG. 5.

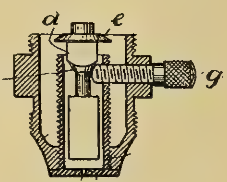
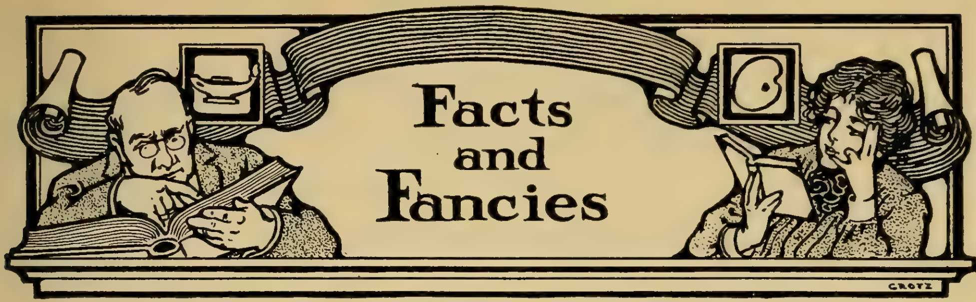



FIG. 6.

Technical journals are rather slow in making jokes, but a trade paper, the "Plumber and Decorator," writing appreciatively of the gas exhibit at the Franco-British Exhibition, finished up the article as follows:—"It is in current phraseology, a grand advertisement; and nothing can be done in these days without advertising. As the American truly observed: Trying to do business without advertising is like winking in the dark. You can keep up a powerful winking and nobody will be any the wiser. That gas exhibition is indeed a powerful wink, but it is not in the dark—very far from it."

CHARLES W. HASTINGS.

London.




# Political Illumination

By Guido D. Janes.

When Charlie Seger was going to have a torch light procession to boom his candidacy for tax assessor of Ducktown, his opponent, Dwight Ires, felt like concentrating all the questionable language in English, French and German, and employing same to express his feelings.

But about the time Dwight felt his worst a friend of his suggested that they confiscate all the torches that were to be used in the demonstration, and thus make a decided failure out of the illumination part of it.

"Thanks for the suggestion," said Dwight. "Here is a cigar. It is a campaign one and gives two-candle power light. Smoke it when you are out late and want to go in dark vicinities."

"Much obliged," returned the friend, taking the present. "Now, the torches are stored in Charlie's barn. Meet me there at dusk, for we want to get them before the parade starts, for you know the demonstration is to-night."

"All right."

At dusk then the two journeyed to the barn, and without being detected secured all the torches in twenty minutes, leaving nothing behind but coal oil stains."

"Won't he be out of sorts," said Dwight, "when he finds all the torches missing."

"He sure will. Good night. I'll see you tomorrow."

"Good night."

MAKING THE DISCOVERY.

About seven o'clock Charlie and his campaign manager went to the locality where they had stored the torches, for quite a collection of voters had congregated in front of the Seger residence ready to march.

"Hurrah for Seger!" they cried vehemently. "Hurrah for our next tax assessor."

CONFISICATING THE ILLUMINATION.

And as they yelled, Charlie did too; but not out of enthusiasm. No. He was yelling vehemently in another manner, mixing a couple of tears with them at the same time; for he had made the discovery that his torches were playing truant from the barn.

"I am a defeated man," he groaned. "Sh," said the campaign manager, "I'll fix it. We must not let the voters know we are feeling blue. It will make you run behind the ticket. I have a scheme."

"What is it?"

"March the bunch to the Acme Electric Supply House. I'll saunter with a bunch to the broom factory. We will come together in half an hour at the square."

This was done, and half an hour later the procession was mobilized on the public square. Each marcher was given a broom stick to which was attached an electric bulb of 32 candle-power. Each bulb was connected to a regular feed wire, and the feed wire was run into an old electric car that had just been chartered for the evening. In the car was a band, Charlie's campaign manager, the car company's electrician and a switch-board.

When all was ready the car started, the band struck up "There Will Be a Hot Time in the Old Town Tonight," and the procession started amid a blaze of glory and success.

When Charlie's manager wanted to give variety to the parade he would throw off the switch in the car and cut down the illumination in the parade to darkness. Then all of a sudden out of the inky blackness of evening he would wave his magic wand—the switch-handle—and bring into life a thousand men with a thousand torches.

Down Main street they went, the principal street of the city, and by the time they had reached Tryon street the parade had become so popular that there were not enough broom handles and candle-powers to go around, and the excess had to content themselves with marching in the rear without the novel illumination in their hands.

When Dwight saw this he was very much chagrined. At first he wanted to cut the trolley wire, and thus put a stop to Charlie's ultimate election, but as he had no technical education to speak of, he was afraid of putting an end to his physical being. Trading a physical life for a political one was a bad deal, he thought.

So instead of doing as above mentioned he came out in the paper next morning withdrawing from the race in favor of Charlie Seger. Yes, he did this, even going so far as to apologize for the rude manner in which he had acted in confiscating the illumination of the proposed parade.

When Charlie saw Dwight the day after the election he was so elated over his own brilliant success at the polls, that he appointed Dwight deputy tax collector.

This of course pleased everyone.

THE PARADE.

# Commercial Engineering of Illumination

## Illuminating Engineering and the Central Station

ROBERT SEVER HALE

GENERAL AGENT, EDISON ELEC. ILLUM. CO., BOSTON, MASS.

Three events which have transpired within the same number of years have almost completely revolutionized the commercial conditions of supplying electricity for lighting purposes. These events are as follows: the general political movement toward the regulation of rates; the advent of electric lamps, both arc and incandescent, which reduce the current consumption for a given amount of light to less than half that formerly required; and the establishment of illuminating engineering as a distinct branch of applied science. In the general craze for government regulation, public lighting has literally been a shining mark. No public utility is more conspicuous, and unfortunately none has been easier to find fault with. A general demand for lower rates for lighting has sprung up in every section of the country. As is generally the case in public reforms, the most radical remedies are the first ones sought; and so, in the case of public lighting, municipal ownership was the first remedy proposed, and in a number of cases has actually been applied. With the operation of some of these municipal plants for a sufficiently long time to determine the practical results, and with calmer and more logical state of mind that has followed the first hysteria, the futility of this remedy has been generally recognized. We believe that most unprejudiced people, on due reflection, will agree that the fundamental principles of our government are opposed to its undertaking the conduct of any business which the individual citizen or corporation can successfully perform; that the conduct of our municipal governments in general has not been such as to warrant their being entrusted with any greater powers than absolutely necessary; and that foreign practice can in no wise be taken as a precedent for American guidance. As an actual living issue municipal

ownership has spent its fury.

A greater degree of governmental regulation of all public utilities has come to stay, and must be reckoned with as one of the fixed conditions under which future business must be conducted. When all the smoke and fog generated by the heat of political excitement and partisan strife have finally cleared away, the people will always be found enlisted on the side of fairness and justice. While the first attempts at public regulation may work injustice and injury to the utilities regulated, it may be said with absolute certainty that such conditions will not long exist, and that reasonable and fair treatment will always prevail in the long run. To be more specific, lighting companies may count definitely on the fact that they are not hereafter to have a perfectly free hand to charge whatever they please, or to make unfair discriminations, but will not be interfered with in the legitimate conduct of their business.

The tungsten incandescent lamp, and the flaming and metallic arcs are not only here to stay, but are displacing the older and less efficient forms of lamps at a more rapid pace than the most sanguine had expected. The improvement in these lamps has been of a sufficiently startling character to attract the attention of the newspapers and magazines, and no scientific discovery or invention ever loses anything in picturesque importance by being thus portrayed. The public are therefore very rapidly becoming familiar with the fact that there are new lamps to be had which are much cheaper to operate than those that have been in general use, and the demand for such lamps will be sure to follow the knowledge of their existence.

In view of lower rates as a result either of compulsion or choice, and of a cut of from 50% to 70% in the quantity of current required to produce a given amount of light, how is the central station to maintain its income above the profit line? There is but one answer—more customers. It is possible that a few customers may be induced to use more current, but the number of such will be scarcely worth counting. The revenues must be kept up by accessions to the list of consumers from those who formerly have not used electric light. Of necessity such new customers must be taken from the present patrons of other illuminants.

By what means can these new customers be secured?

First, by creating a general sentiment in favor of electric light. The surest, if not in fact the only means of creating such sentiment, is to see that every present customer is satisfied. The satisfied customer is one who feels that he is getting value received,—that the company is not merely ready to sell him what he needs, or perhaps must have of necessity, but willing and anxious to see that he gets the very best illumination possible from the current which he pays for. To get the most and the best illumination from a given amount of luminant is a brief but comprehensive definition of Illuminating Engineering. In other words, the satisfaction of the user is simply a matter of the application of illuminating engineering to his needs. "A pleased customer is the best advertisement" is one of the few so-called truisms which always and everywhere holds good. No amount of psychological salesmanship or glittering argument can overcome the deadening effects of dissatisfaction among customers. If new customers are to be attracted, the old ones must certainly be kept satisfied. The science of illumination is a complex technical subject which the user does not understand. He does, however, have a very clear understanding of the general effects which he wants, and a reasonable conception of what he ought to pay for it. It is for the company who takes his money to see that he gets this service.

We have consistently presented the claims of illuminating engineering as a means of securing and holding business since the date of our first issue, and it has been a source of great satisfaction to observe the extent to which this has been put into practice. A particularly conspicuous example has recently been presented in the case of the Edison Electric Illuminating Company of Boston. Anything of note that happens in Boston is interesting by mere virtue of its happening there. Boston is not only one of the greatest of American cities, but perhaps has a more distinct individuality than any other. If we are disposed to

poke fun at her culture and exclusiveness, it is because we know that such culture exists, and that her exclusiveness at least has a foundation to rest upon. Massachusetts has been among the leaders in establishing governmental regulation of public utilities. Its Gas and Electricity Commission, which was established in 1885, has general supervision of its lighting companies, and has apparently exercised its powers with the utmost fairness and deliberation. Its recommendations are therefore cheerfully accepted by the companies subject to its rulings. As a result of this, and also on its own initiative, the Edison Electric Illuminating Company has within the past two years reduced its rates practically one-third, the last reduction having gone into effect on the first of this month. The last reduction was announced early in July through the daily press, and to such an extent as to fully apprise the community of the fact.

In accordance with their general progressive policy, the company established a separate department of Illuminating Engineering, and Dr. Louis Bell, well known as one of the few veteran illuminating engineers, was commissioned to go abroad during the summer to study foreign methods, in order that the department might have the advantages of the best methods of practice followed throughout the world. Not only was this department established but a systematic newspaper advertising campaign was inaugurated to give publicity to the fact. This advertising, in the fairness of the appeal which it makes, and in the progressive spirit which it shows, is a model worthy of the most serious study of all Central Stations. Following are extracts which give a fair idea of its general scope:—

### An Electric Opening.

September First.

This morning at 8.30 o'clock we open the

### New Department of Illuminating Engineering.

We are now ready to send an Expert Lighting Engineer to consult with any consumer of Edison Light free of charge.

He will make no suggestions to you about installing extra lights, but he will try to suggest means and methods to save you money on your light bills or to help you get more useful light, so as to increase the intrinsic brilliancy of your lighting by making available all your light—part of which may now be wasted by absorption or not utilized to full advantage.

Pleasing present Customers is the best way to get new ones.

### Light Science.

With lower electric rates we need new customers

The best way to get them is by pleasing those we now have.

The science of Illuminating Engineering has increased so rapidly that we have sent our best light expert to Europe to see all the developments there, where the wonderful Tungsten lamp was invented.

We are organizing, and shall have ready to open September first, when he returns, a New Department of Illuminating Engineering.

The sole purpose of this department will be to advise with customers as to increased lighting effects without using more light or to secure actual savings by getting the present amount of illumination with smaller lamps or less lamps.

This may reduce your bill say 10 per cent., but it will secure us new customers, from whom we now receive nothing. A pleased customer is the best advertisement.

At first glance, helping you save is a step backward when our business has been materially cut by the reduction in prices, but we think it will help toward securing the new customers we must have.

### Everybody in the Electrical Business Knows the Importance of Illuminating Engineering.

A magazine is published devoted entirely to this subject.

The Society of Illuminating Engineers is a flourishing organization with over 1000 members. The President of this organization is in Europe for us to find what they are doing there on this important subject of Scientific Lighting.

Either thing our patrons want—More Light or Less Cost. We are satisfied if they are pleased. Pleasing them means new customers.

Our policy has resulted in the biggest Electric City in America. But with the loss

of revenue due to lower prices (reduced 20% to 12 cents) we propose to get more new customers now than ever. The best way is to please the old ones first.

The new department will be ready for business in September, by which time our expert will be back from Europe.

If you are a customer, or expect to be, get in your application for inspection and advice now. The department is exclusively for Edison Light patrons.

### Why We are Organizing a Department of Illuminating Engineering.

A touch of the science of lighting (Illuminating Engineering) here and there can do wonders toward attractive store and home lighting.

Until perfect lighting comes there will always be room for improvement.

Recognizing the great strides Illuminating Engineering has made possible by its careful application in distribution of lamps, diffusion of light and the useful refraction or reflection of hitherto wasted light rays, we are organizing and have nearly perfected a department to be devoted to this interesting subject.

It will be entirely at the disposal of our patrons—the smallest as well as the largest. Be your needs ever so modest, or your consumption of electricity however small, do not hesitate to call on us.

Enter your application for examination of your premises and our suggestions for smaller lighting bills, or better lighting at present cost—either as you will.

The expense is ours. Money spent in pleasing customers is well invested. Always before it has returned to us many fold.

The result of this policy, and of the publicity given to it, has already yielded results of the most gratifying character. The department is already crowded with work, and the amount of new business coming in is most satisfactory.

The Central Station offers an absolutely legitimate field for the illuminating engineer. The only restriction as to his absolute freedom is the necessity of using electricity as a luminant; but this restriction maintains practically in a great number of cases aside from those in which Central Stations are interested. The general problem which he has to solve is how to get the best illuminating effects with the least expenditure of electric current. His choice of lamps and accessories is unlimited, and there is no reason why his work should not be as conscientiously independent as if he were a consulting engineer with his own private office. This step on the part of the Edison Company of Boston is noteworthy as marking the first systematic use of an independent illuminating engineering department, systematically advertised in connection with the business department of a Central Station.

# Outline Lighting and the Central Station.

By George Williams.

At recent electrical conventions there has been considerable interest shown in that class of display lighting usually called "Outline"; that is the installation of incandescent lamps to form at night architectural lines of light upon the fronts of buildings. This form of display is used as a grand attraction feature in national expositions, and to draw traffic to recreation parks, and has gained popularity in a few cities where promoted as a civic attraction; yet is strangely neglected by Central Stations in this era of campaigning for high load-factor patronage. Outline lighting has received but a fraction of the attention it deserves from Central Station men, nor has any Station promoting it seen more than a glimpse of the possibilities which it contains.

Nearly every user of electric signs is a possible patron for electric outlining, but there are many possible patrons for electric outline lighting who could not be considered as probable purchasers of electric signs. In other words, where there might be put into commission 100,000 lamps for use in electric signs, there still remains an opportunity to place 200,000 or more lamps in outline lighting.

This inoffensive form of display (inof-

fensive in that it is not yet discriminated against by ward legislation) offers to any business community in which it is liberally installed equal or greater advantages than to expositions or popular resorts.

To 999 persons out of every 1000 an electrically outlined building inspires admiration, just as do beautiful flowers or music, and there is no class of business, or style of architecture that cannot be enhanced by such illumination. As long as there is so large a number of admirers of display lighting there will be concerns to purchase current, and people to favor those concerns who use it; this is just as certain as patronage to theatres, and it is not the fault of the public nor anybody's fault but our own that the business centres of every city are not blazing with beautiful displays every night. If we provide a creditable show the people will come to it, and the bigger the show the bigger the attendance. Where but one merchant in a street uses an electric display he will no doubt profit by its use, but not to the degree that he would if every merchant were using displays.

Merchants or advertisers as a rule have not yet been informed—much less convinced—of the marvelous merit of the possibilities of attraction by electrical displays, although the professional exposition starter and the "show man" have long since utilized this medium for drawing patronage. The operation which would most quickly result in the elaborate illumination of a commercial centre would require:

First:

An understanding among the patrons of the general plan of making the city as a whole the grand attraction of the surrounding country by night.

Second:

(a) Presentation to the community of a few elaborate examples of artistic outline lighting, and (b) specific designs furnished which are suitable to each building.

Third:

A contract for erecting, switching, lighting, and maintaining the electrical display upon a yearly midnight basis.

Upon the company's ability to design, present, sell, execute and maintain service, depends the extent of patronage it will secure. The rate per kilowatt upon which this display service is based, the cost of construction, the character of patronage, and geographical location are of little importance as compared to the three requirements named.

In only a few cities has this class of service been attempted, but where tried along this plan there has been little trouble to secure pleasing results. In one city 172 contracts for this service aggregated 18,000 lamps installed since the first of the late period of business depression. In another city where the total population does not exceed 50,000 a campaign for this class of business was started five years ago. The first contracts secured are still installed and used every night, while the concrete work of five years has made the city famous for its nightly attraction and has brought the central station property from a dilapidated state into a prosperous one. In a very much smaller city where a number of displays were erected four years ago, one outline, for example, is recalled that consisted of 80 4-c. p. lamps, at a flat rate for annual midnight service of $3.60 per lamp, thus earning a gross revenue, from June, 1904, to June, 1908, of $1,152.00. Many a contract that absorbs an equal amount of station capacity does not yield one-tenth this earning.

The individual advertiser usually possesses greater liberality in his ideas than ours, and our proposition for outlining features are too often insufficient to be of use as advertising factors, or even to attract the advertiser's attention. An advertiser who spends $50,000 per year to promote sales through newspaper and other printed matter could profitably spend $10,000 per year upon electrical display. He would be apt to despise a proposition involving one or two hundred lamps; what he needs is one of thousands in order to make his building a permanent landmark, and if he obtains a proper outline attraction, his original $50,000 appropriation will be apt to have double its former power.

The facilities for installing the material for outline are improving; one sign manufacturer now has it made up for stock in 8 foot lengths all ready for erection As in the development of many other mediums for the output of electricity, the handicaps will rapidly decrease as the ambition to accomplish results increases.

# Explanation of Lighting and Power Contracts

(CONTINUED.)

BY A. H. KELEHER.

"The Company agrees that average charge per K. W. H. for current actually consumed during the year under this contract, shall not exceed 10c. per k. w. h., and that at the expiration of each year there shall be a rebate or credit made to the customer for any excess over said average rate. Otherwise this contract shall remain in full force and effect.

"For the first four hours' average daily use of the total equipment based upon the capacity scheduled, 10 cents per K. W. H. (approximately ½c. per 16 c. p. 50 watt incandescent lamp hour, or 5c. per standard arc lamp hour.")

"For all excess above four hours average daily use, 5c. per K. W. H. (¼c. or 2½c.")

A discount of 5 per cent. shall be made when the monthly bills reach $500 and of 10 per cent. when $1000, when paid within ten days of presentation."

A customer then, must guarantee a consumption of 2000 K. W. hours monthly for ten months in the year in order to get on this contract. As is usual in all wholesale lighting contracts, the provision for a refund is made in case, due to the operation of the guarantee clause, the rate should exceed the legal rate. The minimum consumption of 2000 K. W. hours is waived for two out of twelve months of the year, charge being made at the wholesale rate for the actual amount consumed. As the maximum charge of 10c. per unit is made for the first four hours average daily use of the equipment, it is to the consumer's interest to lay out his lighting installation carefully, keeping the kilowatt hour capacity down as far as possible. A difference of a kilowatt or two in the rated capacity, in the case of a long hour customer, will make quite an appreciable difference in the amount of the lighting bills. Central station policy is to put a customer on the wholesale lighting rate when the latter will profit thereby. As a rule, the inspector or contract agent cheerfully advises the customer as to the most profitable form of contract for the latter's particular case.

It is customary in this form of contract to provide for the customer's trimming his own arc lamps, and for furnishing the carbons and incandescent lamps. In other words, such customers are not entitled to lamp renewals. In lieu of a lamp renewal, a lamp allowance which takes the form of a rebate is made to wholesale customers. The lamps allowance is usually a reduction of 1c. fer each K. W. H. consumed as shown in the bill rendered.

It is handy to have a formula by which the amount of one's bill can be figured. There are two cases coming under Wholesale "A":

(1.) Consumption less than 2000 K. W. H. per month. Let x represent the installation expressed in kilowatts.

y is the number of days consumer burns per month.

$4xy \times \$0.10$=charge for first four hours average daily use.

$(2000—4xy)$ $.05=charge for balance of guaranteed 2000 K. W. H.

$4xy \div \$.10 + (2000—4xz)\ \ \$.05 = 2xy + 100.$ $20=lamp allowance to be deducted.

$2xy + 100—20 = 2xy + 80$=monthly bill in dollars.

(2). Consumption 2000 K. W. H. or over per month.

x and y have the same meaning as in (1).

z=total K. W. H. comsumption during the month.

$4xy \times \$.10$=cost for first four hours average daily use.

$(z—4xy)$ $.05 equals cost for remaining K. W. hours.

$4xy \times .10 +\ (x—4xy)\ \ \$.05 = .2xy + .05z =$ gross sost.

Lamp allowance=.01z.

$2xy + 05z —.01z = 2.xy + 04z$=net monthly cost in dollars.

These two formulae will give the amount of the monthly bill, after cash discount of 5 per cent. or 10 per cent. mentioned in the contract has been deducted.

The Wholesale "B" contract provides for a guaranteed consumption of 2500 K. W. hours per month. Agreement is made that the average charge for current consumed during the year shall not exceed ten cents. The rate for current is:

Ten cents per kilowatt hour, with the following discounts:

Should the average daily use of the total equipment amount to

4 hours or more daily, 1c. per K. W. H., amounting to 10 per cent.

6 hours or more daily, 2c. per K. W. H., amounting to 20 per cent.

8 hours or more daily, 3c. per K. W. H., amounting to 30 per cent.

Should the aggregate use of the current amount to 5000 K. W. hours monthly, an additional discount of 1c. per K. W. H., equalling 10 per cent. shall be made.

This is a good contract for long hour burners, but as a whole the "A" agreement is the most favorable to the user. The latter supplies his own lamps, etc., securing in return a lamp allowance discount of 1c. per K. W. H.

Very large consumers burn on the Special Wholesale with considerable saving. They must, however, guarantee a minimum consumption of 10000 units per month during the term of the contract. The schedule of charges is as below:

For the first 15000 K. W. hours, monthly consumption, 5c. K. W. H.

From 15000 to 25000, excess over 15000 4½ K. W. H.

From 25000 to 35000 excess over 25000, 4c. K. W. H.

From 35000 to 50000 excess over 35000, 3½ K. W. H.

All over 50000 3c. K. W. H.

It is understood that the contract covers supply of the current only. The contract provides for the usual lamp allowance.

In the neighborhood of 35000 K. W. hours consumption the rate is very low. This, then, is a very profitable kind of contract for the large consumer, who can use current under the meaning of the contract for both light and power. Large factories, hotels, theatres, and apartment houses are often on the Special Wholesale contract. In the case of the last mentioned, the proprietor pays the lighting company, and in turn collects from his tenants, generally at a considerable profit. This method, however, possesses the disadvantage of entailing a considerable amount of book-keeping.

### Breakdown Connection.

To insure against breakdowns, owners of private plants, where continuity of service is imperative, generally arrange with the city lighting company for a breakdown connection. The charge for this class of service is computed on the readiness-to-serve basis, and is usually very high because it is obviously central station policy to discourage private plants as much as possible. In the case of very large private plants breaking down, the capacity of a central station is liable to be severely taxed. Because of this reason it is customary to stipulate that from Nov. to Feb. no current shall be taken by the consumer from the company's mains during the hours of evening peak load without the previous written consent of the Company. The usual lamp allowance is made breakdown customers.

*(Continued in next issue.)*

## Announcements

The annual meeting of the Empire State Gas and Electric Association will be held in the United Engineering Societies Building, 29 West 39th St., on October 7th, 1908. Among the subjects to be discussed are: Public Policy work of the Association—Standards for Gas Service and Standards for Electric Service, taking as a basis the recent rules of the Railroad Commission of Wisconsin—Taxation of Gas and Electric Companies in New York State with a report from the Taxation Committee—Insurance of Gas and Electric Stations—Review of the Decisions of the Public Service Commissions—Electric Meter Testing with report of the Meter Committee—Accounting with report of the Accounting Committee—Amendments to the Constitution and By-laws with a new schedule of annual dues—Affiliation with the American Gas Institute and the National Electric Light Association.

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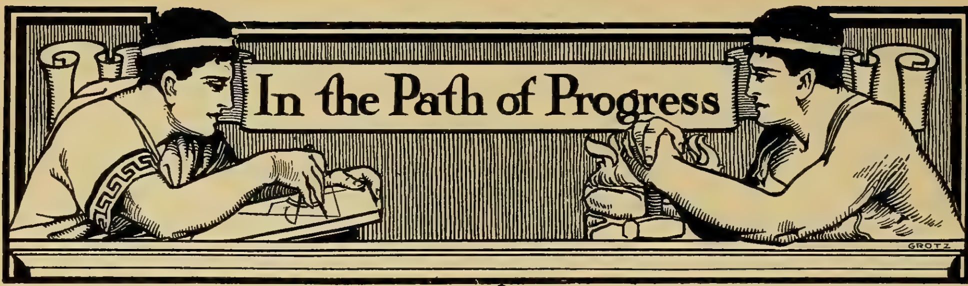
D. C. & Wm. B. Jackson have removed their Western Office from Madison, Wisc., to the Commercial National Bank Building, Chicago. Mr. William J. Crumpton will be in immediate charge of the Chicago office.




## A Self-Starting Mercury Vapor Lamp

The rapid increase in the use of mercury vapor lamps in this country makes any improvement in the details of its mechanism or operation of special interest to illuminating engineers. The necessity of starting the lamps by giving each lamp an individual "tilt" by hand has heretofore been the only point of criticism in its mechanical construction; but the ingenuity of the Cooper Hewitt Electric Company, which was the originator of this system of lighting, has been able to overcome this partial defect.

The new self-starting Cooper Hewitt lamp is thus described by Mr. F. H. Von Keller :

In the most extensively used type of Mercury Vapor Lamp, the so-called "Tilting Lamp," a conducting connection is temporarily formed between the electrodes by tilting the Tube in such a way that the mercury is caused to flow along its entire length and form an uninterrupted bridge between electrodes. When the stream breaks the Lamp starts. The Tube is then allowed to drop back into its original position by gravity.

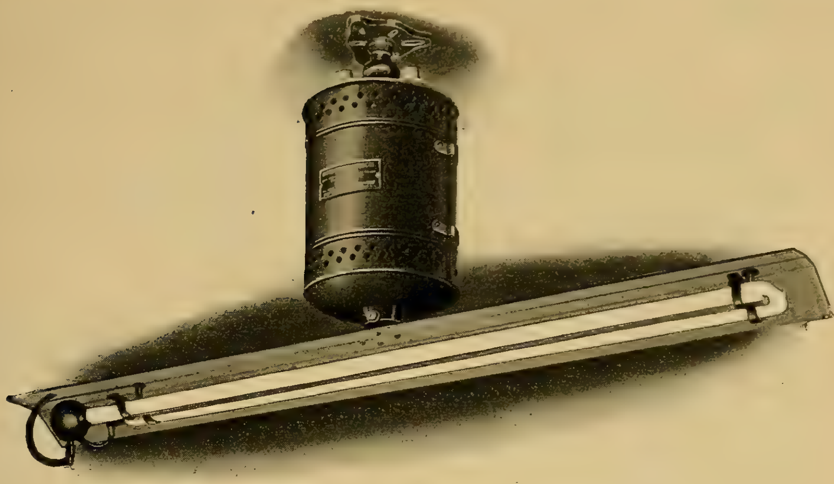
This operation of tilting the Tube is usually performed by hand. In this case it is of course necessary that the operator should approach the Lamp and pull the chain attached to the Lamp Holder for this purpose. In most cases this is entirely practicable, and this type of Lamp has gained a wide field of usefulness.

On the other hand, this operation may be performed by means of a solenoid or an electro-magnet, which renders the Lamp automatic. This method is, however, for mechanical reasons, usually confined to Tubes not exceeding twenty-one inches in length. This type of Lamp is known under the name of "Automatic Tilting-Lamp," and has also come into the market to a great extent.

In some cases it is important that the Lamps be automatic. For instance, in installations where the Lamps themselves are suspended at considerable height, or where for other reasons it is impracticable to have the operator approach each individual Lamp for the purpose of starting. Therefore the type of Lamp described in following has been developed. Here the Tube, which is fifty inches long, is entirely stationary and subjected to no motion to effect starting.

This Lamp is based on the principle that the initial discharge of current can be brought about by applying a relatively high potential across the Tube terminals, thus breaking down the starting reluctance and allowing the supply voltage to send current through the Tube. The high potential across the Tube terminals, the current through an inductance coil in series with the Lamp, by means of a quick-break - mercury - switch, the so - called "Shifter." This is connected in series with a starting resistance across the Tube terminals. When the Lamp is switched on, the circuit is completed through the inductance coil, the Shifter, the starting resistance and the series resistance. The inductance coil, being magnetized by this current, actuates an armature which thereupon causes the Shifter to break connection and open the starting circuit. The inductance is thereby caused to create a high potential across the Tube terminals, sufficient to break down the starting reluctance of the Tube and bring about the lighting.

The successful application of this method presents a great stride forward in the art of Mercury Vapor lighting. For while the automatic lighting of Mercury Vapor Lamps may be brought about by other means, this method—as far as can be judged today,—approaches the ideal most nearly. For this is the only method by which the tube as a whole as well as every part of it remains perfectly stationary during the lighting process. The Tube itself, naturally the most fragile part of the complete Lamp, is thereby submitted to the least possible strain during the starting operation, resulting in decreased breakages and consequently in-



COOPER HEWITT TYPE "U" AUTOMATIC LAMP.

creased life. Moreover, the Tube remains comparatively simple in construction, is easily handled and readily shipped.

The Tube is of the familiar form of the Cooper Hewitt Mercury Vapor Lamp, a straight one-inch Tube of fifty -inches light giving length. It is provided with the customary condensing chamber on one end and an iron positive electrode at the other end. All the auxiliary apparatus is contained in a compact round housing, from which the Tube Holder is suspended.

The Lamp yields approximately 800 c. p. with a power consumption of 3.5 amperes at 110 volts D. C. Thus an efficiency is obtained of approximately .5 watts per c. p. The light emitted is highly diffused on account of the great length of tube, while the light source itself is made least offensive to the eyes by a relatively low intrinsic brilliancy. The light is of the familiar greenish blue, characteristic of the mercury spectrum. This lamp is particularly well adapted to all classes of factory work where a large quantity of highly diffused light at a low power consumption is the principal requirement.

## Show-Window Lighting

There is no single problem of interior lighting which is receiving more attention from both users of light and illuminating engineers than that of show-window lighting, and interest in this important part of the subject is bound to increase. Street lighting has made the use of public highways safe and possible by night. Modern street illumination is not only making their use possible, but exceedingly attractive; and this feature of public illumination is only in its infancy. The tendency is toward a larger and larger use of the streets for pleasure purposes in the evening. The result of this is a great enhancement in the advertising value of the merchants' show windows. The better exterior illumination which is so rapidly coming in not only brings people on to the streets, but necessitates an illumination in the windows themselves which will be conspicuous even in the presence of the spectacular lighting of the street; hence the two-fold necessity of attractive show-window lighting.

For this purpose the recent improvements in both gas and electric lamps are peculiarly adaptable. The inverted gas burner, with its specially designed reflectors, as put out by the Welsbach Company and others, affords an excellent means of window lighting for those who prefer this luminant; while those who prefer the electric light may take advantage of the new tungsten lamps, or the specially designed carbon filament lamp lately introduced into this country by the H. W. Johns-Manville Co., known as Linolite.

Show-window lighting resembles in many respects stage lighting, and for its successful accomplishment demands a special study of each problem in order that the best devices may be chosen for

the particular effects desired. Where the ordinary form of incandescent lamp, either carbon filament or tungsten, is to be used, some form of concentrating reflector is necessary. As it is desirable that the lamps themselves be entirely concealed, an opaque reflector is generally chosen. Messrs. Klemm & Company of Philadelphia have designed special mirror reflectors with metal settings for use with tungsten lamps. One of these is for throwing the light vertically downward, and the other for throwing it out to one side, as well as vertical. As is well known, the best quality of silvered glass forms the most efficient reflecting surface known at the present time. These reflectors should prove exceedingly serviceable where it is desired to use tungsten lamps.

TYPES OF KLEMM REFLECTORS.

There are many instances where limited space and other conditions would render the use of the standard form of lamp either exceedingly awkward or impossible. The Linolite lamp, which is a carbon filament lamp of tubular form having the filament running from end to end, exactly meets these conditions. It is supplied with a small semi-cylindrical reflector, which gives it a very high efficiency in one direction. The lamp and reflector form a single lighting unit, and can be furnished of any desired length. They are particularly valuable for show-case lighting, art galleries, and for lighting book-cases and library alcoves. The last of these is a peculiarly difficult problem for the illuminating engineer to properly solve with the ordinary form of lamp, but can be met with entire satisfaction by the use of the linolite.

These specialties show that the manufacturers of lamps and lighting apparatus are keenly alive to the progress in illuminating engineering, and the demands of the public for better lighting.

## Tungsten Street Fixtures

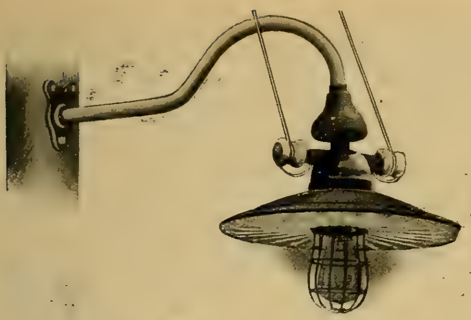
The use of series incandescent lamps for street lighting has up to the present been confined largely to localities where dense foliage and low hanging boughs have necessitated the installation of light sources at frequent intervals and at a short distance above the ground.

Since, however, the economy of tungsten lamps compares favorably with that of arcs, the more extended use of these low units of candle-power is being welcomed by Central Station operators, not only in competition with gas and gasolene lamps, but as affording a more effective distribution than is possible where large units are hung high above the ground and a block or more apart.

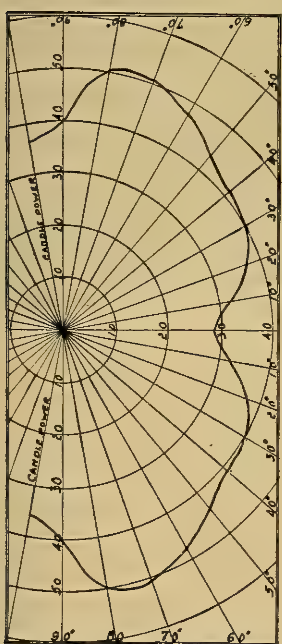
In designing fixtures for this purpose, the Wheeler Reflector Company bring to bear long experience in the manufacture of fixtures for all kinds of street lighting and of reflectors for all purposes of illumination. Their No. 770 has been designed especially with a view to general efficiency, and is substantially built along the styles suggested by the latest practice, as will be noted from the accompanying drawing.

It is especially worthy of attention from the protection afforded the expensive tungsten lamp against malicious breakage and theft by the heavy lamp guard which screws into the reflector.

The porcelain enameled steel reflector is 18″ in diameter and fluted to give the wide candle-power distribution shown by the curve herewith. This, it will be noted



WHEELER STREET LIGHTING FIXTURE.



DISTRIBUTION OF LIGHT FROM WHEELER FIXTURE.

reflects a maximum of light at an angle of from 10 degrees to 20 degrees below the horizontal, and the shape and position of the reflector with relation to the filament is such that light radiated at an angle of 10 degrees above the horizontal is all reflected in a useful direction.

The Wheeler Reflector Company, Boston, Mass., issue a bulletin descriptive of series and multiple Tungsten fixtures well worth the attention of station operators considering the adoption thereof.

## Progress in Illuminating Glass Ware

Whether or not the "constitution follows the flag," it is certain that improvement in illuminating glassware follows improvements in electric lamps. Now that the tungsten lamp has not only proven its technical success, but is an established commercial article, manufacturers of globes and shades have turned their attention to the designing of glassware especially adapted to its needs, and this is a highly significant fact in the progress of illuminating engineering. The makers of illuminating glassware heretofore have given little attention to the engineering side of the business, being quite content if their designs found favor from an artistic standpoint. One of the oldest and largest manufacturers of such glassware is the Phoenix Glass Company, of Pittsburgh. This well-known firm has recently brought out a line of reflectors designed especially for use with the tungsten lamp. The line shows a variety of decorations in crystal glass, besides a reflector of blown opal glass, which is remarkably efficient. Distribution curves and engineering data will be furnished those interested.

# The Moore Vacuum Tube Electric Light

By D. McFarlan Moore.

The Moore light has made decided advances recently. It will be remembered that heretofore in most instances it consisted of a 1¾″ glass vacuum tube of almost any length, distributed in almost any shape, over any area, and has usually been supported on comparatively long fixtures. For some purposes and conditions this form of light has a number of advantages, but from the standpoints of the customer, the illuminating engineer, and the manufacturer of the apparatus, it became apparent that many advantages would be gained by deciding upon certain definite units, both as regards the length of the tube and its form. With this object in view there has been recently installed in the New York Post Office 3

FIG. I.

"Hairpin Unit" tubes, co called because of their shape. As shown by the illustration (Fig. 1) these tubes are in the form of a gigantic hairpin or loop, the two legs of which are separated only 6″. The length of the double tube of this form is 56′ 10″. They are provided, when desired, with a suitable reflector, either of the enamel metal type, or silver mirrored type. The tubes and reflectors are supported on small cast iron fixtures. They are attached directly to the ceiling so that the center line of the tubes is only 6″ from the ceiling. The two ends of this tube, which has a total length of 114′ 2″, terminate in a metal box containing the transformer, which is also attached directly to the ceiling.

Since the tube is an extremely large source its illumination is well diffused, and it may be rightfully likened to that of a skylight, the light from which is bright yet no harsh shadows are apparent because it is so evenly distributed.

These new hairpin units each consume 2400 watts, and since they automatically feed themselves nitrogen from the atmosphere the color of this light is a sunlight yellow with an intensity of about 10.8 candle-power per lineal foot of tubing. The advantages obtained by utilizing such a unit are: first, its performance becomes thoroughly reliable, since its electrical factors, such as voltage, amperes, watts, etc., remain constant, only varying when it is desired to change the color of the light from the standard golden yellow produced by feeding the tube with nitrogen to the standard pure white obtained by feeding the tube with carbon dioxide gas. With such a unit as a basis an engineer can readily decide upon the location, etc., of a given number of units in order to properly illuminate any area.

Due to the tube being placed practically against the ceiling the liability of its being broken or damaged in any way practically becomes nil.

Practically all other advances in efficiency have been made by going to higher and higher intensities, but here is a light-source that goes very far in the opposite direction, but nevertheless has an illumi-

FIG. 2.

nating efficiency

$$\frac{\text{(mean ft. candle and Sq. Ft.)}}{\text{(watts)}}$$

higher than that of any other known form of artificial lighting.

The hairpin units furnish a diffused light that is almost ideal, and since at least two of them are placed over an area of the size shown in the illustration, the liability of both for any reason being out of commission at the same time is remote, and if less intensity of illumination is desired but one need be used at a time. The tubes shown in the illustration form only part of the installation of several thousand feet of Moore Tubing on the mezzanine floor of the New York Post Office, installed over a year ago, and which have successfully met the extremely rigorous local conditions of continuous operation,—that is, they are never out of commission, but are required to burn 24 hours every day in the week. One of these tubes is being fed with carbon dioxide and therefore produces a light that is pure white. In connection with the above tests, Mr. Ives, an expert in color values, made accurate tests on this tube and proved that it produced color values that are not only far superior to those of all other forms of artificial light, but the same as those of average diffused natural light. Dr. Fleming, in England, and the experts of the Siemens-Halske Company in Germany, have also by tests corroborated this statement. There are few cases in which the matter of colors is of so great importance as in silk dyeing establishments. One of the largest establishments of this kind in the world is that of Jacob Weidmann, at Paterson, N. J. Fig. 2 shows Mr. Weidmann, who is one of the greatest color-matching experts of the world, in the color-matching room of his establishment. It will be noted that there is placed on the ceiling a number of tubes bent back and forth in such a manner as to give a thoroughly diffused and brilliant light, and also one, the color value of which is perfect. In many respects matching colors in this room has many advantages over using natural light. The chief one of which, however, is that both its intensity and color values remain absolutely constant, which, of course, is far from being the case with natural light. Delicate shades,—for example, those of lavender, pink or blue, appear, under natural light, decidedly different at morning, noon, and evening, and therefore what is desired is a light that will give a true average of these various conditions, and this is what the tube actually does when fed with pure carbon dioxide.

# Developments in Ornamental and Boulevard Lighting

By Charles L. Eshleman.

Public Improvement Societies, Municipal Art Leagues and Civic Associations throughout the country have in the last few years been particularly active in devising schemes whereby the appearance of their respective cities might be improved. In most cases it is impossible to move or make any radical improvement in buildings already erected, consequently the attention of these societies has been focused on street and park improvements. The initial step has usually been the design of a new lighting system, but in many cases the product furnished by the manufacturer although mechanically perfect has not entirely met the approval of the ever critical members of the Civic Federations, for the reason that the source of illumination was insignificant as compared with the size and height of the posts and the effect produced inharmonious and inartistic.

The wave of civic reform now passing over our country has had its effect upon Central Station lighting companies, both large and small. Electric light companies, especially those in cities of fifty thousand population and over, are spending much time and money in underground cable work and few cities of any prominence are now without electric light systems operated through underground circuits. The feasibility of this method, from an electrical and commercial standpoint has been fully demonstrated by the prominent companies of New York, Boston, Philadelphia, Washington, Pittsburg, Cleveland, Chicago, Baltimore, Minneapolis, Kansas City, San Francisco, and hundreds of other cities, during the last ten to fifteen years. That the interests and safety of the public would be subserved by placing all electric light wires underground in the more congested parts of large cities, where wires are numerous, no one will doubt, and the electric light companies themselves now realize that even from a financial standpoint it is an advantage to them in such localities because of the great saving in repairs and renewals, freedom from interruption of service, prevention of damage suits for injury to persons and property, and the improved appearance of city streets.

The above conditions have been responsible for the development of the Daniels Boulevard Lighting System. The idea was first conceived by Mr. W. E. Daniels operating engineer of the South Park Commission, Chicago, Ill., whose position gave him an excellent opportunity to study all phases of outdoor lighting. The manufacture and exploitation of this system has been undertaken by The Jandus Electric Company, Cleveland, Ohio. As indicated by the several figures, each unit of the Boulevard Lighting System consists of a re-enforced concrete base, shaft and capital of classic design, the whole surmounted by a complete arc lamp mechanism enclosed within a 20-inch opal glass globe.

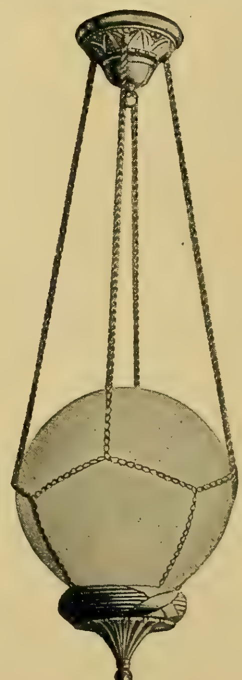
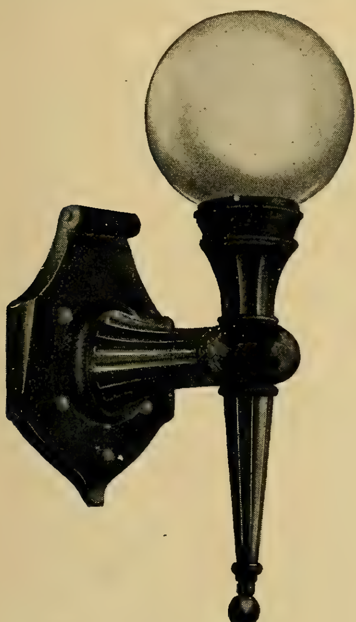


FIG. I.

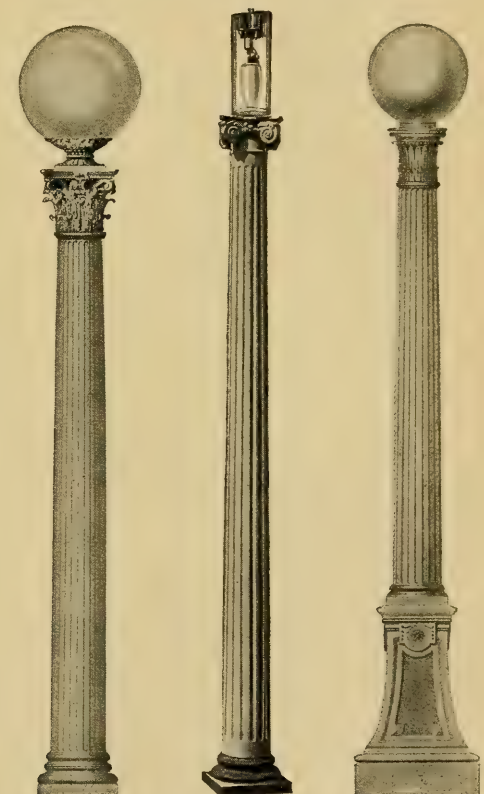
The post is ordinarily made of re-enforced concrete and by proper mixture of ingredients, can be made to correspond to sandstone, marble or granite. Pressed steel posts of all designs can be furnished with the system for practically the same price as concrete. It is stated that the outfit sells for one-half the price of cast iron, that the concrete is indestructible, requires no painting, and is more ornamental than cast iron gooseneck and crook posts now so commonly used for suspending arc lamps. The lamp mechanism is somewhat shorter than the regular type of arc lamp, but allows the use of nine-inch upper and four-inch lower electrodes, thus insuring a life of 125 hours on Multiple Direct Current and Alternating Current types and 100 hours on Series Direst Current and Series Alternating Current types. The use of the large globe insures perfect diffusion, entirely does away with uneven distribution of light, due to the travel of the arc and produces a quality of light heretofore unequaled. Several models of posts are shown herewith. The system has been adapted to sidewall bracket use for indoor and outdoor service.



JANDUS WALL BRACKET.

Fig. 1 illustrates the Jandus ornamental hanging lamp, the outfit consisting of 20-inch gobe, suspended by ornamental chains and enclosing a complete arc lamp.

The lighting of boulevards, parks, public squares, public buildings, capitol grounds, business blocks, private drives, amusement parks and many other applications fall within the sphere of the boulevard lamp. Although no attempt has been made to vigorously exploit the boulevard lighting system, the interest already manifested by electrical engineers, central stations, architects and civic federations has been most gratifying and confirms the manufacturer's belief that the Boulevard Lighting System has an important function to perform, and that its establishment in the lighting field, not only insures better illumination, but heralds the disappearance of the antiquated and barbaric productions in lighting fixtures.



TYPES OF JANDUS FIXTURES FOR DANIELS SYSTEM.


## American Items

COLOR BLINDNESS; by J. H. Springer, *Scientific American,* August 15.

BEAUTIFYING ARCHITECTURAL DESIGNS WITH LAMPS AND LIGHTS; by "R", *The American Gas Light Journal,* August 24.

CONCLUSIVE EVIDENCE OF THE "OVERSHOOTING" OF TUNGSTEN LAMPS AND OTHER INTERESTING PHENOMENA; by J. Stuart Freeman, *Electrical World,* August 15th.

A NEW SOURCE OF ILLUMINATION; by G. A. Johnstone, *Electrical World,* August 15.

Refers to the phenomenon of glow observed in a cell having aluminum electrodes used as a condenser, and describes experiments carried out in a further investigation of the subject.

ILLUMINATION OF A RAILROAD STATION, *Electrical World,* Aug. 22.

STREET ILLUMINATION BY SERIES TUNGSTEN LAMPS, *Electrical World,* August 29.

THE EFFECT OF THE TUNGSTEN LAMP UPON ELECTRIC LIGHTING; by L. P. Sawyer, *Electrical World,* September 12.

The Annual Lighting Number of the "Electrical World," September 5th, contained the following contributed articles:—

THE TUNGSTEN LAMP SITUATION ABROAD; by Dr. Louis Bell.

THE FLAMING ARC LAMP ABROAD; by L. A. Auerbacher.

THE PRESENT STATUS OF THE FLAMING ARC LAMP; by Alfred A. Wolhauer.

THE HELION LAMP, by H. C. Parker and W. G. Clark.

THE TUNGSTEN LAMP; by Francis W. Willcox.

The articles are brief reviews of the several subjects indicated by the titles.

The Annual Lighting Number of the "Electrical Review," September 12th, contains the following contributed articles:—

TUNGSTEN LAMP ECONOMY; by Francis W. Willcox.

THE NEW WESTINGHOUSE NERNST LAMP; by Otto Foell.

THE ILLUMINATING ENGINNEER AS AN ARCHITECTURAL CRITIC, by Bassett Jones, Jr.

THE ILLUMINATING ENGINEER; by Albert J. Marshall.

THE CARBON FLAMING ARC; by Thomas Spencer.

A NEW FIELD FOR THE ELECTRIC SIGN; by Benjamin Wall.

LUMINOUS ARC LAMPS; by H. N. Chamberlain.

THE HELION LAMP; by H. C. Parker and W. G. Clark.

FLAMING ARC LAMPS; by W. H. Jones.

TUBE LIGHTING; by D. McFarland Moore.

SOME RECENT DEVELOPMENTS IN ARC LAMP CONSTRUCTION; by Dwight D. Miller.

THE KUZEL LAMP; by Paul McJunkin.

With the exception of Mr. Willcox's contribution which goes into the matter in detail, the articles are brief reviews.

# Foreign Items

## Photometry of Portable Oil Lamps

(Translated by Progressive Age.)

The very wide use of those classes of illumination which are commonly relied upon for streets, shop windows, public halls and the residences of the wealthier classes, has led to the comparative neglect in photometry, of a proper study of the sort of lamp which in many cases is standard with the poor, viz.: the portable oil lamp. Some data has recently become available, however, which may form interesting comparisons with the more modern lighting methods. Dr. Berthold Monasch, of Berlin, contributes an article on this subject to the Journal fur Gasbeleuchtung (Jan. 25, Feb. 1, 8; pages 61, 81 and 101) for the current year containing the results of his study of the light emitted by ordinary table and wall oil lamps, a brief abstract of which follows:

The first lamp investigated by Dr. Monasch was a 14′″ table oil lamp having a cylindrical flame 2.28 in. high and burning 0.091 pint (34.9 grams) of oil (of specific gravity 0.81) per hour. The photometer used as a Weber, with Lummer-Brodhun prisms. The lamp was first observed without a shade. The results are given in Fig. I., of which the left-handed portion is a vertical intensity diagram and the right hand a Rousseau diagram. The center of the diagram is located at the half-height of the flame The drop in illumination apparent at an angle of 10 deg. below the horizontal is due to the metallic ring (9.45 in. diameter) for supporting the shade. The average values for this diagram are as follows (1 Hefner=0.88 English candle):

| | Hefners. |
|---|---|
| Horizontal intensity | 8.00 |
| Mean spherical intensity | 7.58 |
| Upper hemispherical intensity | 9.25 |
| Lower hemispherical intensity | 5.90 |

The distribution of light when the lamp was equipped with its usual milk-glass shade of a section like Fig II., is given in Fig. III. For this diagram:

| | Hefne.s. |
|---|---|
| Horizontal intensity | 2.8 |
| Mean spherical intensity | 6.48 |
| Upper Hemispherical intensity | 3.92 |
| Lower hemispherical intensity | 9.02 |

The author notes that the distribution of light is now much more in accordance with what is desired from a table lamp; that is to say, it is projected more in a downward direction. Whereas the shade has diminished by absorption the total mean spherical intensity from 7.58 to 6.48 hefners, or by 14.5 per cent., yet it has increased by reflection that of the lower hemisphere from 5.90 to 9.02, or by 53 per cent.

The next lamp investigated was a 16′″ table oil lamp, with a circular spreader-flame and a milk-glass shade supported from below by a clear glass collar, as shown in Fig. V. It burned 0.146 pint of oil per hour. With the chimney bare it gave the distribution shown in Fig. IV, or

| | Hefners. |
|---|---|
| Horizontal intensity | 14.0 |
| Mean spherical intensity | 12.96 |
| Upper hemispherical intensity | 15.34 |
| Lower hemispherical intensity | 10.58 |

With the shade on the results are given by Fig VI. and the following figures:

| | Hefners. |
|---|---|
| Horizontal intensity | 4.0 |
| Mean spherical intensity | 7.96 |
| Upper hemispherical intensity | 5.70 |
| Lower hemispherical intensity | 10.2 |

In this case the shade, while decreasing the total mean spherical intensity from 12.96 to 7.96, or by 38.6 per cent., has also decreased the lower hemispherical intensity by 3.6 per cent. This unfortunate result Dr. Monasch attributes to the use of clear glass as a support for the shade, instead of metal ring and rods.

The next lamp investigated was a 10′″ wall oil lamp like Fig. VII., burning 0.0675 pint of oil per hour. When studied with the reflector and support removed it gave the results shown by Fig. VIII. and the following figures:

| | Hefners. |
|---|---|
| Horizontal intensity | 7.9 |
| Mean spherical intensity | 7.14 |
| Upper hemispherical intensity | 8.14 |
| Lower hemispherical intensity | 6.14 |

With the reflector in place, the lamp gave a distribution in a horizontal plane through the center of the flame as shown by Fig. IX. The vertical distribution in a plane normal to the reflector is shown in Fig. X. From the showing thus made Dr. Monasch decries the use of these lamps for kitchen illumination, as is so often the practice, arguing that the concentration of illumination at an upward angle of 40 deg., as shown, is just the opposite of what is needed in kitchen work. But it is not remarked, as seems obvious, that this particular angle of concentration must be due to the more or less accidental vertical relation between the flame and the reflector center; which is, or should be, capable of adjustment until the light was concentrated at any desired angle near the horizontal.

For comparison with these oil lamps with wicks, there was studied an alcohol incandescent lamp, with regenerator action, burning 0.078 pint of 95 per cent. spirit per hour. The naked lamp gave the curve shown in Fig. XI., which Dr. Monasch regarded as an almost ideal distribution of light for the general illumination of a room, and the following figures.

| | Hefners. |
|---|---|
| Horizontal intensity | 18.5 |
| Mean spherical intensity | 14.27 |

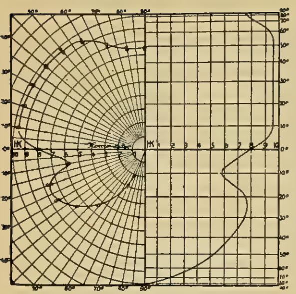


FIG. I. TABLE OIL LAMP, 14''', WITHOUT SHADE
CIRCLES 1 HEFNER APART

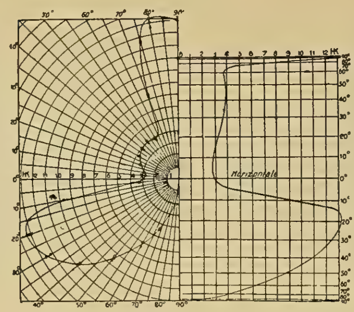


FIG. III. TABLE OIL LAMP 14''' WITH SHADE.
CIRCLES 1 HEFNER APART

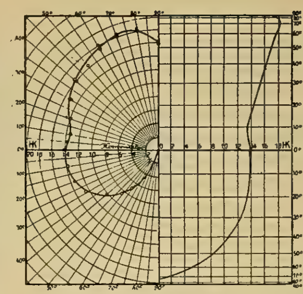


FIG. IV. TABLE OIL LAMP, 16''' WITHOUT SHADE
CIRCLES 2 HEFNERS APART

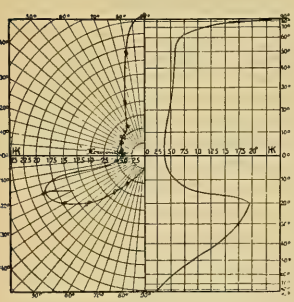


FIG. VI. TABLE OIL LAMP, 16''', WITH SHADE
CIRCLES 2.5 HEFNERS APART

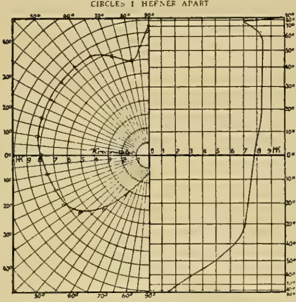


FIG. VIII. WALL OIL LAMP, 10''' WITHOUT REFLECTOR
CIRCLES 1 HEFNER APART

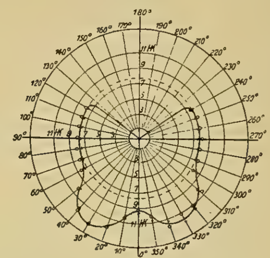


FIG. IX. WALL OIL LAMP, 10''', WITH REFLECTOR
HORIZONTAL DISTRIBUTION

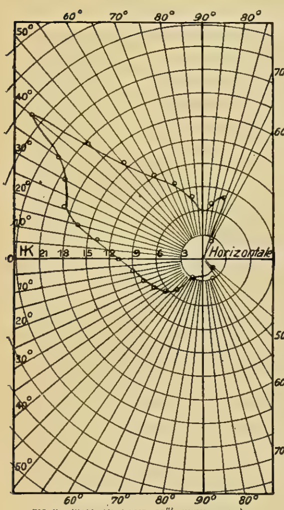


FIG. X. WALL OIL LAMP, 10''', WITH REFLECTOR
CIRCLES 3 HEFNERS APART

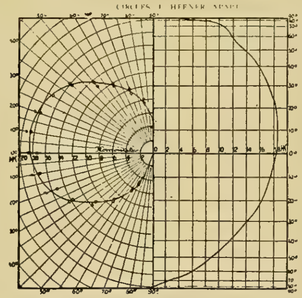


FIG. XI. ALCOHOL INCANDESCENT MANTLE LAMP, WITHOUT SHADE.
CIRCLES 2 HEFNERS APART

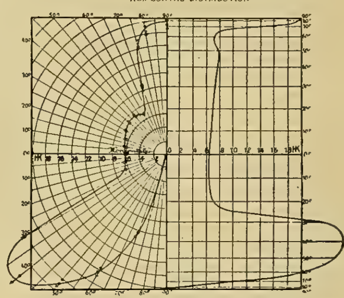


FIG. XII. ALCOHOL INCANDESCENT MANTLE LAMP, WITH SHADE.
CIRCLES 2 HEFNERS APART

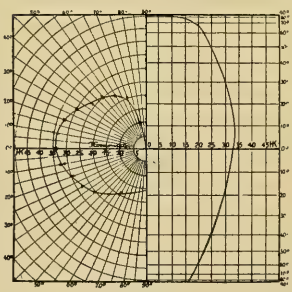


FIG. XIII. CARBON-FILAMENT ELECTRIC INCANDESCENT LAMP
CIRCLES 5 HEFNERS APART

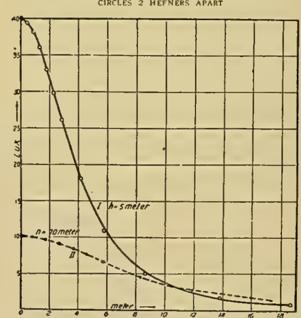
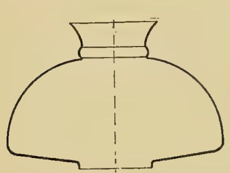


FIG. XIV. ILLUMINATION OF A HORIZONTAL SURFACE BY UNIFORMLY DISTRIBUTED LIGHT.



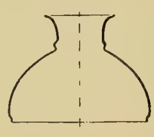


FIG. V. SHADE FOR 16''' OIL LAMP; MILK GLASS AND CLEAR GLASS. FIG. II. SHADE FOR 14''' OIL LAMP AND FOR SPIRIT LAMP

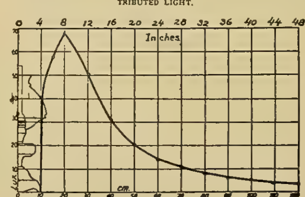


FIG. XV. ILLUMINATION OF A WHITE HORIZONTAL SURFACE BY THE 14''' TABLE OIL LAMP WITH SHADE. (FLAME 14½ IN. ABOVE SURFACE).

| | |
|---|---|
| Upper hemispherical intensity | 15.84 |
| Lower hemispherical intensity | 12.70 |

When the lamp was equipped with the same globe as that used with the first lamp mentioned, and shown in Fig. II., the results were those shown by Fig. XII. and in the following figures:

| | Hefners. |
|---|---|
| Horizontal intensity | 6.0 |
| Mean spherical intensity | 11.06 |
| Upper hemispherical intensity | 7.50 |
| Lower hemispherical intensity | 14.62 |

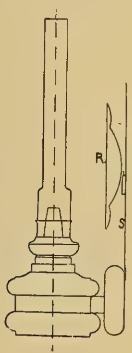


FIG. 7.

While the shade reduced the total mean spherical intensity from 14.27 to 11.06, or by 22.5 per cent., yet it increased the mean lower hemispherical from 12.70 to 14.62, or by 15 per cent.

Attention is here called to the preponderating influence of the shade upon distribution. Figs. I. and XI., for instance, show very different distributions of intensity coming from the two bare flames in question; but when these flames are equipped with the same shade, the results, as shown by Fig. III. and Fig. XII., become closely similar.

The series of observations also included the test of a carbon-filament electric lamp, of 32 Hefners nominal capacity, using a 190-volt 50-cycle alternating current. The results are given in Fig. XIII. and in the following figures:

| | Hefners. | Watts per Hefner. |
|---|---|---|
| Horizontal intensity | 34.0 | 2.54 |
| Mean spherical intensity | 27.45 | 3.15 |
| Upper hemispherical intensity | 28.35 | 3.05 |
| Lower hemispherical intensity | 26.55 | 3.26 |

In connection with the above figures the author calls attention to the sharp criticism which should be directed at the present current practice of rating all sorts of lamps (excepting electric arcs) by either their horizontal or their mean spherical intensity. In the majority of cases, horizontally projected light, or light distributed evenly in all directions, are both to a large degree useless. In the great majority of cases it is illumination in the lower hemisphere which is of use. In a minority it is that in the upper hemisphere. If any single practice is to cover all cases, that now current with electric arcs, of specifying the mean lower hemispherical intensity, should be adopted. But, for a rational solution of the problems in illumination, the particular angle at which illumination is most desired should be known, specified and supplied.

As to the purpose of the lamp shade, the author points out that, whereas the use of a shade always decreases somewhat the mean spherical illumination, yet in the majority of cases it actually increases the lower hemispherical. Thus, while in reality an absorbent of light, it increases that available for human use.

It is not sufficient, however, to consider merely the mean intensity in the lower hemisphere. The distribution at different angles within that hemisphere is of prime importance. Nor is it to be accepted, as so commonly taught, that the lamp gives the best illumination which has its intensity evenly distributed angularly, even if all confined to the lower hemisphere. If the rays from the lamp were intended to penetrate the human eye direct, as is the case with lighthouses for instance, this might be the case; the eye would then not be annoyed by abrupt changes in intensity as it moved about. But what is desired is an equal distribution of illumination of the surfaces which are to be seen, and this is a quite different matter.

Usually the surfaces to be illuminated are vertical ones, and it is on this basis that Kruss formulated his expressions for the proper angular distribution of intensity in the Journal fur Gasbeleuchtung for 1906. But, in the study of table lamps it is not vertical surfaces, but the horizontal surfaces of the table, which need an even degree of illumination; and this would be far from what was derived from a lamp having an even angular distribution of intensity. Fig. XIV. gives what would be received instead. Its curves show the number of lux which would be received, at different horizontal distances, by a horizontal plane above which was suspended a uniform light source of 1,000 Hefners. The full line applies to a light placed five meters above the surface, the broken line to one ten meters high.

Reversing this idea, we may derive the intensity requisite at different vertical angles in order to give uniform illumination of a horizontal plane. For a uniform illumination of ten lux from a light source placed eight meters (26.2 ft.) above a horizontal plane, the following intensities are needed:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Angle with horizontal | 20° | 30° | 40° | 50° | 60° | 70° | 80° | 90° |
| Hefners | 15,900 | 5,100 | 2,400 | 1,400 | 990 | 750 | 680 | 620 |

Referring now to the lamps actually investigated, Fig. XV. gives the distribution of illumination as it would be actually received by a white horizontal surface, situated 13⅜ in. below the center of the flame of the 14‴ table oil lamp, with shade. For the 16‴ lamp, having its flame center 10⅝ in. above the table, the results are given numerically, as follows:

| Angle with horizontal ... | 15° | 20° | 25° | 30° | 35° | 40° | 45° | 50° | 55° | 60° | 65° |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Distance from lamp to where ray strikes table | 37.8 | 28.7 | 22.0 | 17.7 | 14.8 | 12.8 | 10.8 | 8.7 | 7.5 | 5.9 | 4.7 ins. |
| Illuminat'n computed from Fig. IV without shade.. | 3.8 | 7.5 | 14.2 | 22.7 | 30.8 | 40.0 | 46.7 | 53.0 | 51.0 | 53.0 | 52.0 lux. |
| Ditto from Fig. VI with shade.... ...... .. . | 4.9 | 11.0 | 20.3 | 31.5 | 42.5 | 52.5 | 55.0 | 54.0 | 55.0 | 57.0 | 56.5 lux. |
| Percentage superiority of shade over naked lamp | 29 | 47 | 43 | 39 | 38 | 31 | 18 | 2 | 8 | 7 | 9% |

The remaining lamps of the series are also represented in Dr. Monasch's article, by curves showing the illumination of both white and green surfaces; but their general result is merely to corroborate the marked unevenness of illumination shown by Fig. XV.

Dr. Monasch quotes Dr. Cohn, of Breslau, as stating that the human eye could see as well with 60 lux as with daylight. The same authority gives 12 lux as the hygienic minimum for the eye. The 14‴ lamp gives the larger figure at a distance of only 6 to 10 inches from the flame center. At a distance of 27½ in. the hygienic minimum is reached. The 16‴ lamp increases these distances to 14 and 28 in. respectively. For the spirit incandescent lamp these distances are 14 and 22 in., for the electric incandescent without reflector, 14 and 31 in., and for the same with reflector, 20 and 34 in.

## Compiled by J. S. Dow.

**Reflected Lighting with Metallic Filament Lamps.** *(Electrician Aug. 14.)*

A description of the system of indirect lighting with osram lamps at the Inns of Court Hotel, Holborn, London. The lamps are arranged in conical opaque reflectors so as to throw the light upwards on to the ceiling. The article is accompanied by some effective photographs showing some of the rooms in the hotel.

**Die Graphische Konstruktion der Reflectoren**, by E. W. Weinbeer, (*Elec. Anz.*, Aug. 2.)

The article discusses a series of graphical constructions for working out the shape of reflectors intended to provide a constant and uniform ground illumination.

**Das Beleuchtungswesen in Turkei**, by G. Herlt, (*J. f. G.*, Aug. 1.)

The author gives a resume of the state of illumination in Turkey. In most cases no attempt is made to secure anything but an extremely dim interior illumination, and petroleum lamps and candles are used almost exclusively.

Difficulties at the Customs and elsewhere interfere with the introduction of gas and electric lighting, which have made but little headway. Acetylene is considered dangerous.

Schanz and Stockhausen, K. **Die Schadigung des Anges durch Einwirkung des Ultraviolet-ten Lichtes.** (*E. T. Z.*, Aug. 13).

Schanz, F. **Demonstration des durch ultraviolettten Strahlen zu erzeugenden Lidschluss-Reflexes und der durch diese Strahlen veranlassten Fluoresce der Linse.** (*Z. f. B.*, Aug. 20.)

Voege. **Ist durch das ultraviolette Licht der modernen kunstlichen Lichtquellen eine Schadigung des Auges zu befurchten?** (*E. T. Z.*, Aug. 13.)

Schanz and Stockhausen consider the action of ultra-violet light upon the eye to be injurious, and quote, in support of their contention, the well-known effect of these rays in producing slow-blindness, and possibly also cataract. The inflammation of the eyes resulting from incautious exposure to the arc lamp and the

mercury vapor lamp are attributed to the same cause.

The authors have found that ordinary glass does not absorb the most dangerous rays, and Schanz describes a demonstration of the effect of the rays in causing fluorescence of the eye-lens of an animal, which seems to prove this point very clearly. The authors therefore propose to surround artificial illuminant with a special variety of glass which completely absorbs the obnoxious rays, and illustrate their article by a series of spectro-photographs showing its action.

Voege, on the other hand, describes some experiments from which he draws the conclusion that for a given brightness of illumination, daylight contains a greater proportion of ultra-violet radiation than all the artificial illuminants examined by him with the exception of the Regina arc lamp, and the quartz mercury vapor lamp.

He therefore considers that there is no object in surrounding artificial lights with special absorbing glasses, which are not considered necessary in the case of daylight.

PHOTOMETRE A LECTURE DIRECTE, by Ch. Fery (*Jour. de Physique*, Aug.)

The author has devised a direct-reading photometer, consisting essentially of an apparatus resembling that used in the Radio-micrometer, in front of which is placed a suitable screen. This screen absorbs the radiation in different parts of the spectrum in such a way as to cause the distribution of sensitiveness in the spectrum to resemble that of the eye. As an indication of the correctness of the instrument he mentions the results of some texts of the efficiency of various glow-lamps which approximate to the recognized correct values.

ILLUMINATION AND HYGIENE, by L. Gaster, (*Jour. Soc. Arts*, Aug. 21.)

This article sets out the claims of good illumination from the hygienic aspect, on grounds substantially the same as those previously put forward in The Illuminating Engineer (London, Jan. 4 and June.)

Devaux, E. OBSERVATIONS SUR LA COMMUNICATION DE MM BROCA ET LAPORTE. (*Bull. Soc. Int. des Electricians*, July, 1908.)

Lerche. DER STAND DES BELEUCHTUNGSTECHNIK UND DIE BELEUCHTUNG IM POST U. TELEGRAPHBETRIEBE. (*Archiv. f. Post u. Teleg.* 1908, Nos. 8 and 9; Ann. der Elektrot., No. 8, 1908.)

ELECTRIC LIGHTING.

Wedding, W. NEUERE ERRUNGENSCHAFTEN IN DER ELEKTRISCHEN BELEUCHTUNG (complete paper, *E. T. Z.*, July 30.)

Remané, F. VERGLEICH VON BETRELBSKOSTEN KLEINER BOGENLAMPEN UND HOCHKERZIGER OSRAMLAMPEN, complete paper and discussion (*E. T. Z.*, Aug. 20.)

Attention was first drawn to the above two papers which have now appeared in full.

That by Wedding deals with recent papers in electric lighting generally, and is chiefly of interest on account of the results of a series of tests on metallized carbon, tantalum and wolfram lamps contained therein. Wedding believes in the possibility in metallic filament glow lamps for 220 volts from 16 H. K. upwards, and suggests that the future competition between gas and electricity will now be based on convenience and upkeep rather than cost of energy.

Remane gives a complete series of curves and tables with the object of demonstration that osram high c. p. lamps, (and these lamps are now made for candle powers up to 400), are preferable to the smaller arc lamps. Some discussion turned on the behavior of such lamps, run two in series on 220 volts, aim their sensitiveness to temporary overrunning.

DIE ELEKTRISCHE BELEUCHTUNG UND IHRE ENTWICKLUNG (*Elek. Anz.*, Aug. 16.)

An interesting and up-to-date general article on electric lighting. Among other matters dealt with some particulars are given of a variety of flame arc with vertical carbons due to Blondel. The lamps will run for twenty-four hours without recarboning and can also be burned three in series on 110 volts or six in series on 220.

Duschnitz, B. METALLISCHE LEUCHTFADEN IN DER FABRIKATION UND IN DER PRAXIS, (*Elek. Anz.*, Aug

9, Aug. 20.)

Schmidt, J. UBER ELEKTRISCHE STRASSENBELEUCHTUNG DEREN SYSTEME UND RHRE RATIONELLITAT. (*Elek. Anz.*, July 26, Aug. 2, 6 and 23.)

These two articles have been running for some time in the Elektrischer Anzeiger, and were commented upon in the last review. That by Dusschnitz deals mainly with recent processes for the manufacture of metallic filaments, the most recent instalment containing some reference to the Helion Lamp.

Schmidt deals in a very exhaustive fashion with the many factors influencing the cost of street lighting.

Walter, B. EINFLUSS VON SPANNUNGSSCHWANKUNGEN AUF DIE HELLIGKEIT VON NERNSTLAMPEN (*E. T. Z.*, July 16.)

Walter criticises the results previously obtained by Hirschauer with respect to the effect of voltage-fluctuation on the light given out by the Nernst lamps. He finds this sensitiveness to depend very greatly on the particular iron-wire ballasting resistance that happens to be in series with the lamp.

On an average, a 5% change in P. D. caused a change in candle-power of about 12%. Individual cases in which a change of the order of 30% to 40% occurred, were, however, noted.

OTHER ARTICLES.

Ennsbrunner, A. DIE QUARXLAMPE. (*Elek. u. Maschinelle Betriebe*, 1908, Nos. 6 and 7; *Ann. der Elektrot.*, No. 7, 1908.)

Long, F. W. ELECTRIC STREET LIGHTING (*Jour. Inst of E. E.*, London, Aug., 1908.)

LAMPE A FILAMENT METALLIQUE "PHILLIPS" (L'ELECTRICIEN, Aug. 8.)

GAS LIGHTING, ETC.

Lux, H. UNTERSUCHUNG EINES BENOID GAS APPARATUS (*Z. f. B.*, July 30 and Aug. 10.)

Lux describes some tests on some benzine air gas burners. The burners give, on the average, 1.2 to 1.5 litres per H. K. hour, and the arrangement is said to be simple in operation. The calorific power of the gas is somewhat less than that of ordinary illuminating gas, but a higher flame temperature is obtained with the result that the blue end of the spectrum or the light yielded is accentuated, and the radiant efficiency is higher than in the case of an ordinary gas burner.

Meyer-Liegnitz. GLUHKORPER-FESTIGKEITSPRUFER (*J. f. G.*, Aug. 14.)

Describes a new form of apparatus for testing the power of resisting shock on the part of incandescent mantles.

EDINBURGH AND LEITH COMMISSIONERS PROVISIONAL ORDER, TO REDUCE CANDLE-POWER OF GAS TO 14. (*G. W.*, Aug. 1, *G. L.*, July 28.)

This decision is important as indicating the tendency of modern gas legislation to rely mainly on calorific value rather than illuminating power. The gas supplied in Edinburgh has been of exceptionally high candle-power for this country. Quite recently it was as high as 25. Yet only about 15% of the gas generated is used in flat-flame burners, so that the decision to revert to a lower illuminating power seems justified.

THE "HELLA BUSHLIGHT," ROD FILAMENTS FOR INCANDESCENT GAS LIGHTING, (*J. G. L.*, Aug. 14.)

Some of these curious "bushlights"—mantles they can hardly be termed—are on view at the Franco-British Exhibition. They consist of a bundle of rods composed of rare earths, 0.8 mm. in diameter, and 25 to 30 mm. in length. The filaments can be worked into any desired pattern while in the plastic state, and the color of the light given by them can be controlled by altering the chemical composition. Though fragile to the touch, the filaments are said to be less subject to the effects of vibration than ordinary mantles.

PRESSGAS ODER LUFTGAS. (*J. f. G.*, July 25; see also *J. G. L.*, Aug. 25.)

A continuation of the discussion of the relative merits of "compressed-air" and "compressed-gas" systems for high pressure lighting. The former is considered preferable by the author, partly because the system does not entail special meters, and also because the tendency to leakage is less troublesome.

# Miscellaneous News

BALTIMORE, MD.—Within the past week several large out-of-town concerns have notified Mr. Robert J. McCuen, superintendent of lamps and lighting, that they intended to enter the field as competitors against the American Lighting Company, the concern which has the contract at present for maintaining the street lamps on the thoroughfares in Baltimore. One concern—namely, the Sunshine Street-lighting Company of Pittsburg—has written Mr. McCuen, asking for information relative to the requirements that must be fulfilled by prospective bidders for maintaining the street lights of Baltimore, and the Superintendent of Lamps and Lighting was informed that the out-of-town concern would be on hand to submit a proposition next March, when the present contract with the American Lighting Company expires.

According to Mr. McCuen, the lukewarmness of foreign lighting concerns to enter into active competition with firms in this city has in a large measure kept the municipality from obtaining as low prices for keeping its street lamps in order as it would have been possible otherwise.

By the saving of a lump sum next year Mr. McCuen says that he will be able to install many new lights in those sections of Baltimore which need better lighting facilities, and that there is no better way to begin than by trying to make a better and more advantageous contract for "light maintenance" next year.

WESTFIELD, MASS. — Arrangements have been practically completed whereby the Petroleum Light Company, a Springfield concern, will locate in Westfield. The product is a light from kerosene comparing in brilliancy to gas light. A large number of orders have been received already and await manufacture.

The prospect that the United States automatic Lighting Company will decide to locate here looks decidedly brighter. A. W. Allen, the president and general manager of the company, is the vice-president and manager of the P. P. Emory Company of Springfield, makers of brass goods and lamp fittings, and was for many years master mechanic for the Miller Company, of Meriden, Ct., the largest lamp manufacturers in the world. The Springfield people who are interested in the project with Mr. Allen sought expert opinions upon his system, the patent rights and his own record before entering it.

KANSAS CITY, MO.—It will cost the retail merchants in the west 300 block in Twelfth street about $6 each to have a part in the extensive lighting scheme for downtown retail streets. The block is between Central street and Broadway.

"There are ten trolley poles in the block," said C. E Hough, one of the promoters of more lights. "We estimate that the brackets will cost $12 each. That would be $120. There are twenty retail businesses in the block. Two of the proprietors have refused to pledge subscriptions towards the lights. We don't care about that. We are going ahead with our plans. After we get the lights, we are going to advertise the block. We will force persons to trade with us."

The formal organization and election of officers has been effected. The merchants met at the Century Hotel. They plan also to place electric signs across Twelfth street at Broadway and Central street with the numbers of the block outlined with electric lamps.

R. E. Richardson, general manager for the Kansas City Electric Light Company, gave an exhibition of different designs of street lighting on Walnut between Ninth and Tenth last night in the presence of a number of city officials, in order to prove that ornamentation as well as effectiveness can be secured in municipal lighting.

ST. LOUIS, MO.—In pursuance of a sweeping policy of retrenchment instituted by John I Beggs, all except six of the 23 solicitors of the Union Electric Light and Power Co., by request, have tendered their resignations, to become effective Sept. 1. The contract department was notified that it would have to cut its salary list $1000 a month. As the result of this order all

the high salaried solicitors were asked to resign. Most of the solicitors who will remain are young. The retrenchment policy will affect every department of the company. Word has been sent down the line in Union Electric offices that the company is to be run on the same principles as the gas company. All the high salaried men are to be discharged and cheaper men and girls employed. The retrenchment policy of the gas company has resulted in wholesale reductions in salaries, and several sub-stations have discharged nearly half of the men. Many of the Union Electric employees who are to be retained received notice yesterday of reductions in salaries. The order has gone out to the heads of the operating departments to slice salaries wherever possible.

BUFFALO, N. Y.—The Buffalo Gas Company has conveyed through President Humphrey of New York, an ultimatum that unless the city pays, or makes some satisfactory arrangement to pay the company's bill for gas supplied, amounting to about $125,000, the gas will be turned off on the 10th inst.

The city's representatives prefer to take no stock in the company's threat, yet, if carried out, it would raise a pretty howdy-do along Delaware avenue and throughout the West Side, where gas prevails for street illumination to the exclusion of electric light.

Bids have been received for vapor lamps which are said to be superior to the old gas lamp, but it would take time to install this novelty after it is favored by the Council and Mayor. Two sample vapor lamps are now on view on Delaware avenue near Niagara Square. They give a superior light but cost more than the old gas lamp. The gas question in all its bearings is likely to give rise to lively debate when the Council reconvenes.

SAYRE, PA.—The demonstration at the test plant of the Sayre Gas, Light & Power company was most satisfactory. The inventor, Charles L. Myer, of Baltimore, was present, and explained all the details to the large number of people who visited the place during the evening.

COFFEYVILLE, KAS.—Kansas towns that are paying all the way from $50 to $85 each per year for electric arc street lights ought to come to Coffeyville and get some pointers. Here the city owns its own electric light plant and will soon set the pace in cheap street lighting by furnishing itself 150 arc street lights at an annual cost of little more than $20 per light. When the present improvements at the light plant here are paid for, and that will not be long distant, the plant will pay a profit sufficient to more than pay the interest on the bonded debt, so it is wholly probable that Coffeyville will within five years see the time when her street lighting will cost her absolutely nothing. But be that as it may, the plant is now capable of supporting 150 street lights, and now all that is left for the citizens to pay by taxation is the interest on the bonded debt amounting to $3,125.

COUNCIL BLUFFS, IOWA.—Council Bluffs streets may soon be lighted with the new tungsten incandescent lights.

For the last month the Citizens Gas & Electric Lighting Company has been quietly experimenting with the new lamps on the lines where incandescents are used, and the results have been satisfactory.

The company has replaced the thirty-two candle power carbon lamps with the forty candle power tungstens whenever the former have given out, until now more than half of the total number of incandescents are of the new pattern. They seem to give from two to three times as much light as the carbon lamps and to almost equal the inclosed arcs.

The lighting contract calls for the thirty-two candle power size, but the lighting company is using nothing smaller than forty candle power.

BALTIMORE, MD.—In view of the constant objection by property owners of the placing of arc lamp posts opposite their premises, Superintendent of Lamps and Lighting McCuen is seriously considering the advisability of experimenting with the tower system of street illumination in Baltimore. Several days ago Mr. McCuen learned that this system, while yet young, had been tried in three or four of the larger cities of the South and West, and had not only proven equally as satisfactory as the individual pole lights, but was somewhat cheaper in the long run.

The advantage of such a system is that all poles between the blocks, which would ordinarily be used under a plan of illumination such as this city now has, are eliminated, the thoroughfare being lighted by means of the reflection from the tower lights placed at the intersection of certain streets.

To make sure of this fact, the Superintendent of Lamps and Lighting asked for plans and specifications under which the tower system of street lighting is installed, and yesterday he spent most of the day in making a careful study of them. With only a theoretical knowledge of this newest method of lighting a big city, Mr. McCuen is, nevertheless, enthusiastic over the rather novel idea, and he does not hesitate to say that it is worth trying by his department.

As Mr. McCuen understands the plans, no poles are used in between the blocks, but light is furnished by a tapering tower placed at the corners, the lights from the tower being thrown the entire distance of a block by means of huge reflectors.

The

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## *Contents of this Issue:*





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Cable Address Illumineer. Lieber's Code used.

# *There is Room for All.*

*In the earlier days of the wonderful development of mechanical genius which distinguishes modern civilization from all that has gone before, the announcement of a new labor-saving machine created consternation and distrust among those whose hand labor the invention was intended to supplant. Time and events have proved that such fear was groundless. It has been found that the cheaper the product the greater its consumption; and whenever human labor is supplanted by the forces of nature other and generally more elevating occupations await the laborer in new fields. Improvements have multiplied to an almost incomprehensible extent; the result has been an uplifting of mankind in general, and the laborer in particular.*

*So in the development of illumination. With each new illuminant has come the prediction, accompanied with more or less misgivings, that all the older illuminants must give way to the newcomer. The results have amply proven the fallacy of such belief. Candles and oil lamps, which were the earliest light-sources of civilized man, are more largely used to-day than ever before in the history of the world. Illuminating gas, which placed artificial lighting among the public utilities and necessities, has several times had its doom pronounced by the enthusiastic admirers of new light-sources, but the fact has been clearly established that the use of gas for illuminating purposes is constantly on the increase, and there is no likelihood of any diminution, at least in the immediate future.*

*Human nature is so constituted that its wants are never satisfied; fulfil one demand, and two others spring up in its place. Desire grows with fulfillment. We are yet as far from reaching the limit of the use of light as we are from reaching a perfect code of laws, or the end of mechanical inventions.*

*Every new or improved source of light is an addition, not a substitute, and is a direct benefit to mankind. Light is a good thing, and the danger of getting too much is extremely remote. The field for its use is so large, and so sparsely covered as yet, that there is room for all the different lighting interests to work without touching elbows. Let every one mark out his own course and pursue it with confidence in his own work and his own product, and without fear or malice toward any of his co-workers in the field.*

E. L. Elliott.

FIGS. 1 2 3 4 5

# The Development of Gas Street Lighting Fixtures

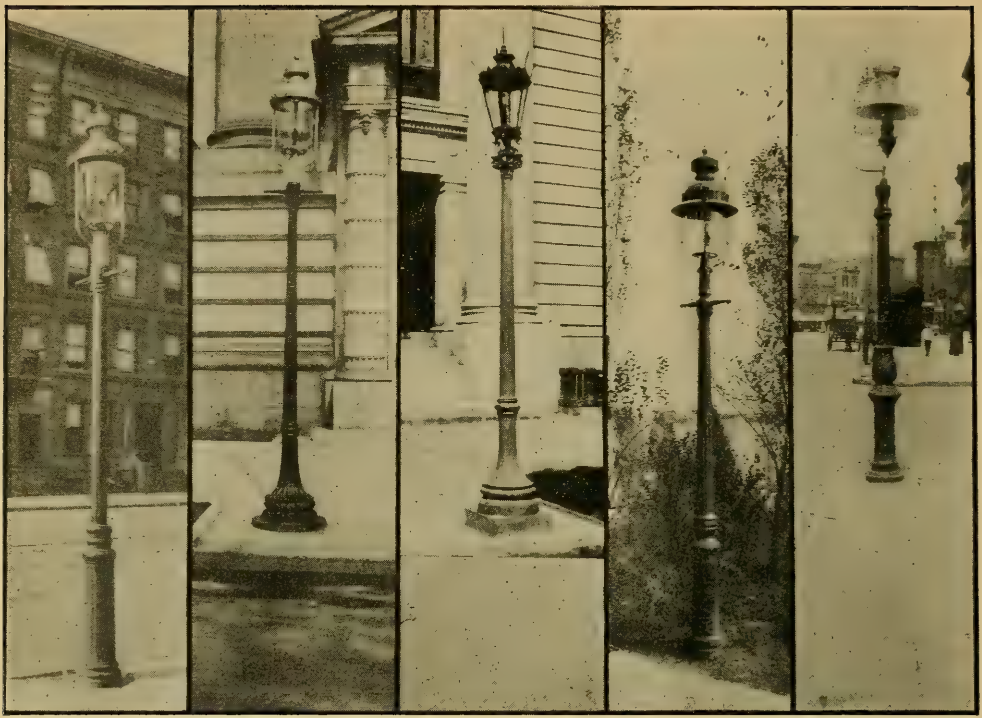
By H. Thurston Owens.

The development of the gas lamp-post, and its equipment in this country has been attended with very little interest from the public, the press, or the gas company. Those who have taken an interest were the city officials, the lamp-post manufacturers, the lantern manufacturers, the companies contracting for the maintenance of the lighting systems, the comic papers, and last but not least, the small boy.

Lamp posts are much more in evidence than is generally realized. As an example of this let us take the fifteen largest cities in this country; we find that there is one post for every 50 people dwelling therein, or approximately one post for every ten families. Only 30 per cent of these posts are electric, so that in point of numbers the gas lamps have a long lead.

In general the designs of the posts have been quite similar and those in use today are principally castings of either one or two pieces, the latter predominating as they are less expensive to buy and maintain, as it is only necessary to repair the post which is defective or becomes broken, and not the whole post. The joints used are usually of lead, calked as in regular pipe work, although turned and bored joints are sometimes used. The one piece castings are illustrated in Figs. 1, 4 and 9; the two piece in Figs. 2, 3, 5, 6 and 11, and the last named in Figs. 7, 8 and 10.

There has been more variety in the designs of the lanterns and the improvements in recent years has been almost wholly confined to this portion of the fixture; but curiously enough the post and the lantern have rarely been furnished by the same individuals, nor have they been designed as a single unit.



FIGS. 6 7 8 9 10

All of the fixtures illustrated are in use to-day and represent the developments of the past decade.

Let us first consider the posts illustrated. In point of numbers the design shown in Figs. 3 and 6 is by far the most popular and the least expensive. Those shown in Figs. 2 and 5 are of similar construction but show peculiar manifestations of individuality which do not enhance their value from an artistic standpoint. Those shown in Figs. 1 and 9 are one piece castings and their simplicity is in great contrast to those shown in Figs. 4, 5, 10 and 11. The last four mentioned show very clearly the difference between successful ornamentation represented by Figs. 4 and 10 as compared with the ungainly appearance of Figs. 5 and 11.

The posts illustrated in Figs. 7 and 8 are identical in design but are equipped with different lanterns, and although the latter is far from efficient owing to the fact that the lantern frame obstructs a considerable portion of the light, it is a much more attractive fixture.

As previously stated the principal improvements of recent years have been in the equipment and not the post and we will discuss this feature along the lines of Art vs. the Small Boy.

In the matter of interior illumination there is considerable strife over the momentous question of the architect versus the illuminating engineer, while in street lighting the problem has been the question of art versus the small boy.

One of the most annoying as well as costly features of street lighting has been the question of wilful destruction, but the matter has been almost entirely disposed of by the improvement in the appearance of our lighting fixtures.

Gas lamps have suffered more in the past than those of their glaring competitor, the electric light, principally because there were more of them and they were easier to hit, being nearer the ground. The custom of placing ornamental lamps in front of buildings by the owners is older than that of regular street lighting, and one of the additions to the artistic attractions of New York is shown in Fig. 11. This post was erected by a publishing house located in the neighborhood of

Franklin Square, and it was equipped with the usual lantern. The local order of street gamins were not appreciative of the honor conferred upon the neighborhood, so they promptly proceeded to smash it. This continued with such regularity that the owner decided to enclose the lantern in a frame work of iron. The destruction continued so that to-day not even a vestige of either lantern or burners is left.

FIG. II.

Now let us compare this with the regular city installations.

The familiar open flame gas lamp equipped with square lantern shown in Fig. 1 furnished the major portion of the street illumination until the advent of the mantle lamp. Before the lamps were changed from the former to the latter type the writer knows of installations consisting of approximately 5,000 lamps and the number of pieces of glass replaced on account of breakage amounted to nearly 40,000 pieces per year. Upon some of the prominent streets lanterns of the boulevard type shown in Fig. 2 were installed and the matter of breakage was considerably reduced. As soon as the lamps were changed over to the mantle type and a still handsomer fixture installed as shown in Fig. 4, the matter has ceased to be one of importance.

The lantern shown in Fig. 3 was found to be unsatisfactory as the ventilator rested upon the glass globe, which was of one piece, and an improvement over this is shown in Fig. 2 where both the ventiiator and the globe rest upon the supporting arms. One of the earlier types of lanterns constructed for mantle lamps is shown in Fig. 4 being somewhat similar to the older boulevard type. A later design is shown in Figs. 5, 6 and 7 where the supporting arms are reduced to two in number and the material is cast instead of wrought iron. The lantern shown in Fig. 9 is used for mantle naphtha lamps, the oil reservoir being cleverly concealed by the simple method of making the reflector cylindrical instead of flat so that from its appearance it is often mistaken for a gas lamp.

The design shown in Fig. 10 is a private lamp maintained by a gas company in front of its office and the writer's opinion of it can only be expressed by quoting Kipling:—"It's pretty, but is it art?"

# Illumination Among Some of the World's "Submerged Tenth"

By L. Lodian.

Amidst the wealth and luxury of the lighting of nowadays,—as instanced in almost every issue of this magazine,—'tis well to take a glance at "the other side." Why? Because it enables one the more to appreciate modern improvements. Examples have already been given in this periodical, during the past three months, of the "survival of the worst" in lighting; yet "there are others still."

## The Cork-Gas of Old Iberia.

In parts of old Espana, where cork-trees most do flurish, the peasants have neither candles or oil for lighting, yet manage to "light up" tolerably well in their farm-houses by filling a big iron kettle with refuse cork-bark, closing the tight-fitting lid, and placing on the hob by the open fire. The spout is turned toward and almost over the fire, and after due heating, the volatile gas and smoke begins to emerge from the small hole at the end of the spout, and inflames above the wood fire. From time to time it goes out,—more smoke,—jumps into flame again; and so on till exhaustion. Then the kettle is removed, and another (which has been "heating up" meantime in immediate proximity) takes its place. Thus the cork-gas-lighting goes on till the family go to bed.

But there is a double object in thus carbonizing the cork-refuse. It is not alone to secure lighting: in the morning, the kettles are emptied of their charred remains, which ultimately finds its way into world-commerce as "Spanish black," —one of the intensest black-browns known among pigments.

Essayed on a regular gas-retort scale, cork-gas yields a good flame; the odor is not disagreeable; and for a time the opera-house in one of the continental cities was entirely lighted by cork-refuse gas. But it proved a failure,—because the cork-black by-product (which had been counted upon to "show a profit") now necessarily began to show up in such quantities that the market could not absorb it at any price. This ended the history of cork-gas-lighting on a commercial scale in old Hispania but its use is still continued for home-made gas among the poverty-stricken farmer-peasants of the southern Cid land.

## Curious Gas-Connection.

A queer "wrinkle" in gas-connection is practiced by many of the mafia-and-camorra gentry of Manhattan's Italia-side. (They evidently brought the idea from their own cities, where the pure all-rubber gas-tubing is used, and not the made-up wire-woven tubing as known to us.) When the Italian basement-owner wishes to connect up two pieces of gas-tubing, he simply inserts a slip of makaroni into each end. As he is familiar with various diameters in makaroni-tubing, he is enabled to secure a snugly-fitting joint. One I asked how long his makaroni connection has been thus doing duty, and he replied: "Cerka dui anni" ["about two years."] The makaroni tubing is almost absolutely gas-tight, but naturally brittle.

Modern fire-insurance experts rank three leading causative factors in the history of fires today: gas-light, electric-light and—israelite! If they knew a little more of the dago and his fragile makaroni gas-tube-connection ingenuity, (mostly concealed by the rubber ends being drawn close together), they might get a little more elucidation as to "causative factors" in the first of the trio mentioned.

## The Candle-Nut of the Tropics.

There are a couple of candle-nuts known to the seeker of illuminating curios. One is used by the natives on some of the islands of the Pacific tropics; the other has its habitat in tropical America. Specimens of this last are only available for illustration here. It is something like a giant brazil-nut, but with smooth shell; is of a creamy, most nutritious taste—hence its name of "cream-nut" among the American-speaking settlers of the Amazon; but the native name is "sapukaia";

also, colloquialy, vela-nuez (candle-nut). The largest specimens are the size of one's fingers; but these are picked out by the natives for their home use, both for lighting and food, and only the "small fry" are permitted to find their way to northern markets,—and very few sacks at that, even. The candle-nut is smokeless, odorless; burns with a nearly pure white light, is very steady, and only requires "touching off" with a match. The charred portion, however, has to be knocked off from time to time to prevent the dimming of the light. Singular to relate, this candle-nut has a natural "central draft", in that there is a single central narrow perforation or tube throughout its length (always more marked in the big specimens),—which also permits of its being easily mounted on a splinter or twigs.

## Illumination Among the Russian Submerged Tenth.

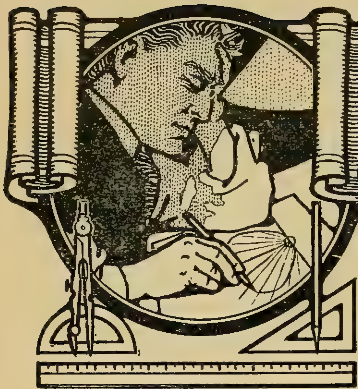
The most miserable, wretchedest, poverty-stricken sight I ever saw in my life was one gloomy November morning, over a decade ago, on the outskirts of Mockba, central Russia. Near the railroad track on the Tyla line, are a number of oil-factories. Between these and the line there is almost a quarter-mile expanse of soggy marsh-land, slightly sloping towards the railroad. The water trickling in-and-out and through the irregularities of the marshy surface is of a dirty yellow color. Here and there over the marsh could be distinguished, moving about in the wretched cold gloom, a score of decrepit bent old figures, with small iron pail in one hand and a tin-cup in the other. Ever and anon they would dip the latter down into the muddy oozelets, scoop up a little of it, and pour it into the pail.

## Their Only Illuminant.

Never having seen such a sight before, I inquired what they were doing, and was told they were skimming-off what they could catch of the refuse kerosene which escaped with the waste waters from the factories in the distance. This they used for lighting their miserable quarters at night. If they were industrious enough, they could gather two or three kopeks' worth of the foul, just-burnable stuff,—"save that much in candles",—if they had any, even.

I have seen many "submerged-tenth" sights in this world—from the kolinga-bazar bengali of Kalikata to the kallekuyo atorante of Buenos-Aires, the geisha dives of Tokio to the lonsdal-streeters of the Australian Melburn; but for heart-sickening poverty, nothing to equal that hockba urban scene! And a couple of miles further on or more, you are in the heart of wealthy Mockba, with its miles of (at night) arc-lighted npocnekts (bulvards), and stores resplendent with every scheme of illumination.

I have often thought of that Mockba refuse-kerosene-oil sight. Almost the same degree of hopeless poverty pervades the whole of the Russian masses. But enough of this lugubrious "illumination among the world's submerged tenth"! Albeit interesting, sufficient has been cited to make one thank the Lord he is in the home of light and liberty—America.



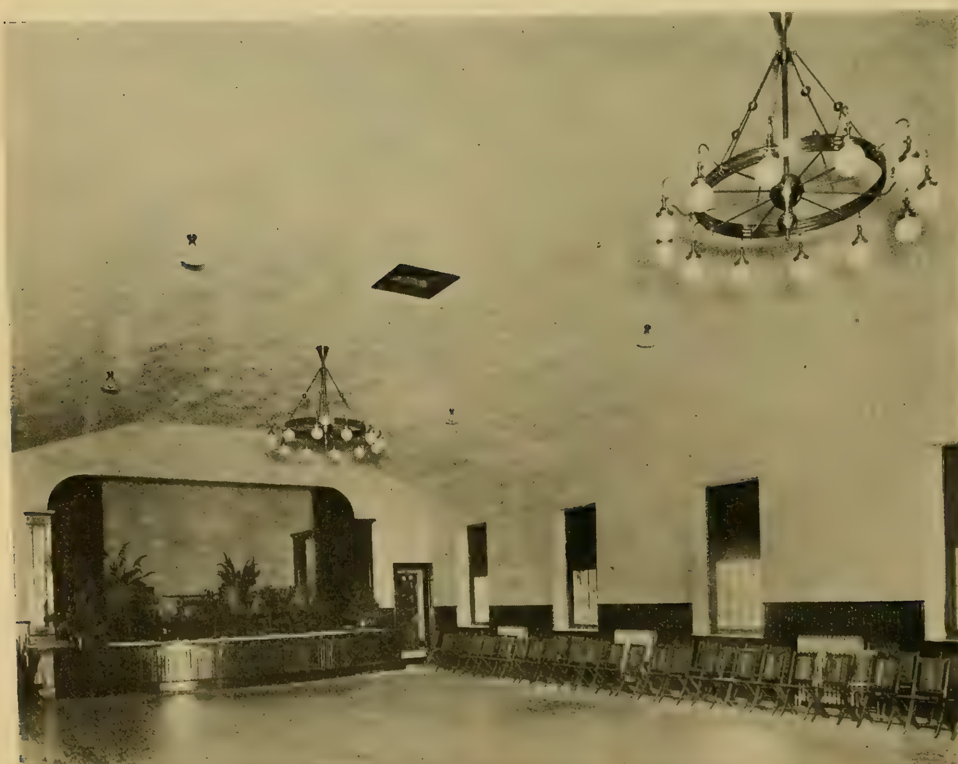
# Practical Problems in Illuminating Engineering

## Lighting of the Ridley Park Auditorium, at Chester. Pa.

By J. D. Shattuck.

The new inverted incandescent gas lights together with the Electric Jump Spark Lighter have made possible the lighting of churches, halls, dark windows, etc., with gas, by placing these lights in more desirable locations for proper effects.

A recent installation of this character has been placed in the new Auditorium at Ridley Park, which building was formally opened Saturday, October 3rd. The main hall is 59′ x 31′ 8″ x 18 feet ceiling. This room is lighted by two 12-light fixtures, equipped with inverted gas lights.



RIDLEY PARK AUDITORIUM.

The lights are 13 feet above the floor. The spread of the fixture, which is illustrated, is nearly 6 feet. Each light is enclosed in ground glass globe. The lights are high and strong enough to flood the room with light even with rather dark trimmings. The effect is abundance of light, but pleasing to the eye, as the source is not in line of vision when looking in any direction in the room. The spark lighting system is controlled from behind the stage and is the system described by Mr. T. J. Litle, Jr., in this Magazine under date of January, 1908.

It is expected these lights will greatly aid in ventilating the room. There is one large opening in the ceiling, and one or two more will be made if needed and star ventilators put in the roof. The fresh air will be brought into the room through basement windows and holes in the floor under the steam radiators. Gas lights properly placed with fresh air supplied are the best ventilating agents that can be obtained.

A properly ventilated public building is almost an exception and too little attention is given to this subject by architects. In our illumination of large spaces, let us fight for ventilation. It has been proven that an unventilated room with a gas jet burning has a better atmosphere than when lighted by electricity. The gas man has the induced circulation to help him.

# Southern Lights

BY R. P. WILLIAMS.

"Northern Lights" have been known and admired for many centuries, but unless all signs fail " Southern Lights" are to now have their innings. Brilliantly lighted stores and show windows have become a fad with the merchants of

A KNOXVILLE SHOW WINDOW.

Knoxville. Each one seems to be vieing with the other to see who shall have the whitest spot on the "Great White Way". This fad is much more than a mere notion or spurt of transient rivalry. Any one who passes up or down the streets in the evening, and observes the throng of sight-seers and pleasure-goers, and notices the attention which they give to the many attractions along the "way" will agree with old Polonius,

"Though this be madness, yet there's method in it."

"Far from the madding crowd" may be all right for the hermit, but our merchants and wide-awake citizens are great believers in crowded streets, and are learning more and more to appreciate the fact that the way to get out the crowds is to make the streets attractive, and that the only way to make them attractive at night is to give them brilliant and spectacular illumination.

Both the gas and electric companies are working along well considered plans each striving in a spirit of friendly rivalry to see who shall do the most toward making Knoxville the "City of the Southern Lights." The gas company reports an increase in business over 1907, showing that "hard times" and "panics" are not sufficient to even turn down the gas, much less to put it out. The illustration is an example from among numerous installations of gas light that have been put in under the present efficient management.

# Lighting of an Indianapolis Store Window

The accompanying illustration shows a window of the Taylor Carpet Co., Indianapolis. The window on the right is lighted with 17 inverted burners, equipped with angle shades, against thirty-four 16 c. p. incandescent lamps in the window on the left.

## Fixtures and Accessories

# The Possibilities of Artistic Effects in Gas Fixtures

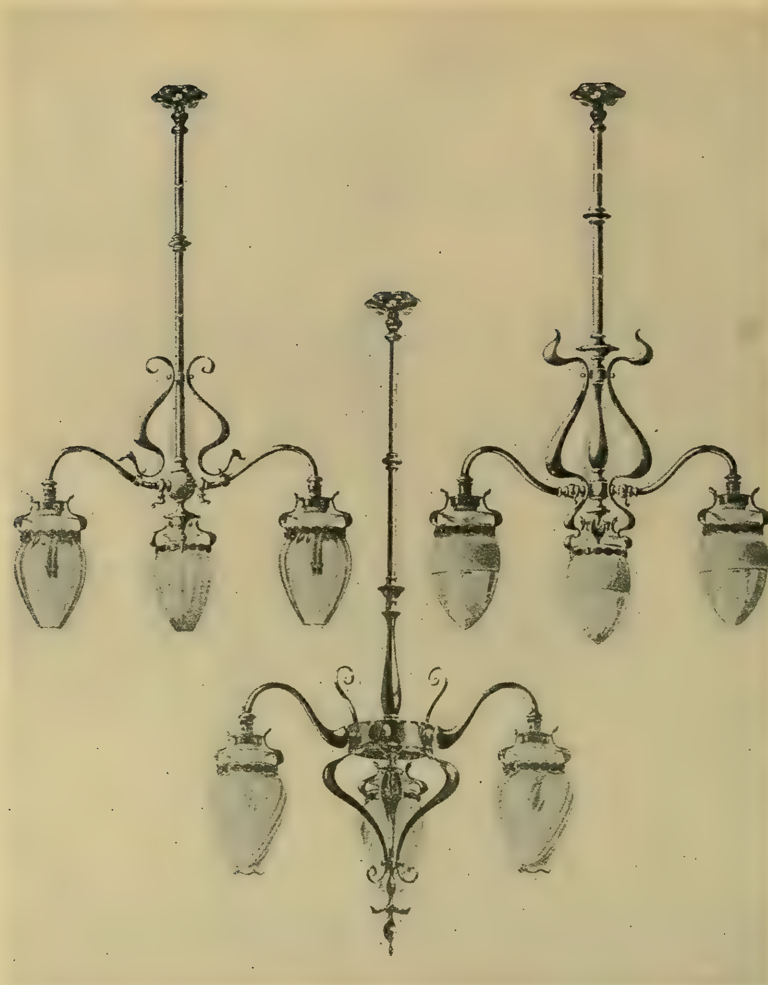
By E. L. Elliott.

There is no denying the fact that the electric incandescent lamp, by reason of its greater adaptability, both in form, candle-power, and ability to be operated at any angle, the absence of uncovered flame, and the facility with which it may be turned off or on at a distance, may be given a greater variety of artistic effects than gas light. On the other hand, the cases in which full advantage is taken of its adaptability to produce special artistic results are comparatively rare and unimportant. This is due to two causes: first, the traditions of illumination that have come down from the days of candles and oil lamps have thus far over-shadowed all other considerations in the artistic treatment of lighting fixtures; and second, the great majority of lighting installations neither demand nor justify such originality or novelty of design as would preclude the use of gas. In fact, practically all of the cases of electric illumination in which gas could not be substituted, so far as physical conditions are concerned, might be classified as spectacular lighting. With the latest forms of electric lamps, which can be burned successfully only in a pendant vertical position, there is practically no difference in the limitations imposed upon artistic design between gas and electricity.

An examination of modern high-class lighting installations, and the catalogues and sketches of American fixture manufacturers, will at once disclose the fact that by far the larger part of all modern artistic fixtures are either adaptations, or reproductions of fixtures that were originally produced from one to three centuries ago. As the candle was the only luminant then in use, various imitations or adaptations of the candle are to be found in a great number of the most pretentious designs of the present time. Whether or not such imitation is a legitimate form of art is a theoretical question which need not be discussed here. Architects and decorators, who in most cases are the keepers of their clients' consciences on all matters of decorative art, demand the candle effect, and the fixture manufacturer very rightly conforms to this demand.

Now, the candle can be most easily and most effectively imitated by the use of gas light. A short tube of opal glass sufficiently simulates the candle, while the open gas flame, though of totally different shape, is approximately an imitation of

AN ENGLISH ART NOUVEAU DESIGN FOR FLAME GAS FIXTURE.



ENGLISH ART NOUVEAU DESIGNS FOR INVERTED GAS LIGHT FIXTURES.

the candle's flame. Every one of the fixtures of the French periods, which as models of artistic design have never been surpassed, are very easily adaptable to gas lighting.

The more efficient mantle burner has caused us to lose sight of the fact that there is a certain artistic effect in a flame that is entirely lacking in a fixed incandescent body. This was admirably expressed by Mr. Hartt in his description of the "Lights of Boston:"—

"It has this superiority over electricity. It moves. It trembles, flickers, is sensitive to the least breath of wind. It is fire itself, not an immobile semblance of fire. ******* While electricity itself is incomparably brighter, there remains a sort of hushed solemnity about its motionlessness. On the other hand, gas, blazing in countless dancing jets, excites a wild, barbaric joy, such as no incandescent orbs or lines or constellations can afford."

The first advice of the illuminating engineer is generally, "keep your light-sources entirely out of sight." In the case of electric lights this advice is good; the incandescent filament or the electric arc has no merit in itself to attract the eye: it is a source of light, nothing more. You would no more think of gazing at an electric light as a thing of beauty than you would think of sitting down to look at a steam radiator.

FIXTURE FOR INVERTED BURNERS IMITATING ELECTRIC EFFECTS

A flame possesses an element of irrestible attractiveness, whether used as a light-source or as a source of heat.

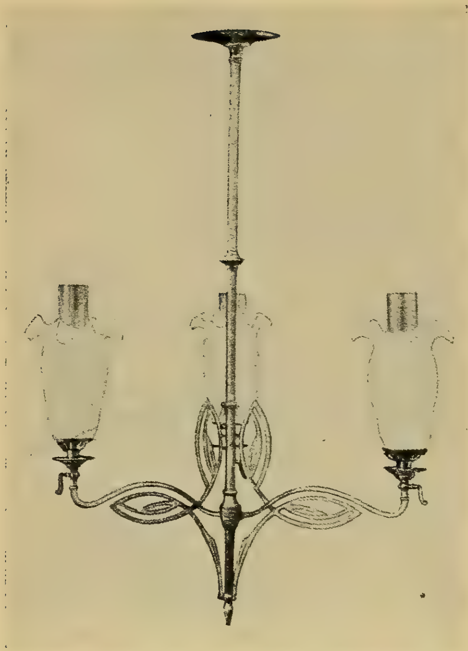
In general then, every "chandelier" design, i. e., fixture for holding candles, is reproducable as a gas fixture.

Again, by far the greater majority of all electric fixtures are also readily adaptable to gas light. A most curious fact connected with fixture design is the effort on the part of the promoters of each particular luminant to imitate the effects of some other luminant. Thus, both the gas and the electrical interests have assiduously imitated the candle. The electric light devotees have imitated gas, at least so far as the general construction of fixtures is concerned, and the gas interests have very successfully imitated the most familiar effects of the electric light. The inverted mantle burner, which marks the latest improvement in gas lighting, unquestionably had its origin in a desire to meet the incandescent electric lamp in its advantage of hanging in a pendant position and giving no shadows below. Mantle burners have also been designed which so closely imitate the electric lamp, even to the socket, as to escape detection by the ordinary observer.

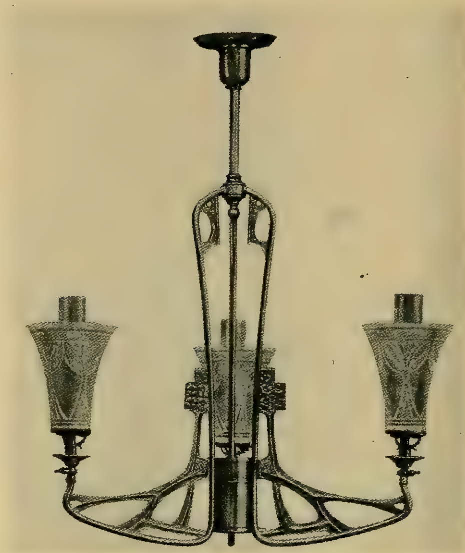
A gas fixture requires a tube or pipe for the conduction of gas, and in the majority of cases electrical fixtures simply use this tube construction for the conduit wires, thus entirely avoiding any differentiation in construction and appearance between the two luminants. Occasionally, and of late rather more commonly, electric fixtures are suspended by chains, through the links of which flexible conduit wires are drawn. In Europe the flexible wire itself is very largely used to support the lamps and their accessories; but this construction has never come into use in this country owing to the ban placed upon it by the insurance under-writers. The flexible cord is really the only structural feature in a fixture that plainly declares the source of illumination. The designers of gas fixtures, however, have been equal to the occasion, and have used fine copper tubes, twisted together to imitate a cord, to suspend inverted mantle burners, thus very successfully imitating the electric effect. Why it is thought necessary to imitate in order to be artistic is an idiosincracy of the human mind which we have never been able to fathom.

While the gas flame has a certain inherent artistic value which absolutely defies imitation by the electric light, the incandescent gas mantle in itself has no artistic value, and in this respect is on a par with the electric lamp; but by the judicious use of decorative effects in the metal construction, and of glassware designed to form an integral part of the fixture rather than an individual unit, such a burner may be made as artistic a lighting device as any form of electric lamp.

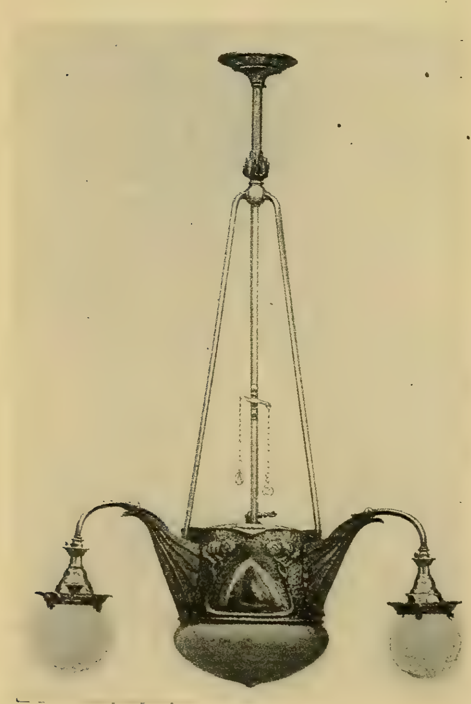
There is a common saying that "Imitation is the sincerest form of flattery". To imitate the electric lamp is to acknowledge its superiority: why should the gas people wish to imitate it? The inverted mantle burner is a positive improvement in gas lighting It gives a somewhat higher absolute efficiency, and a better natural distribution of the light. These are good and sufficient



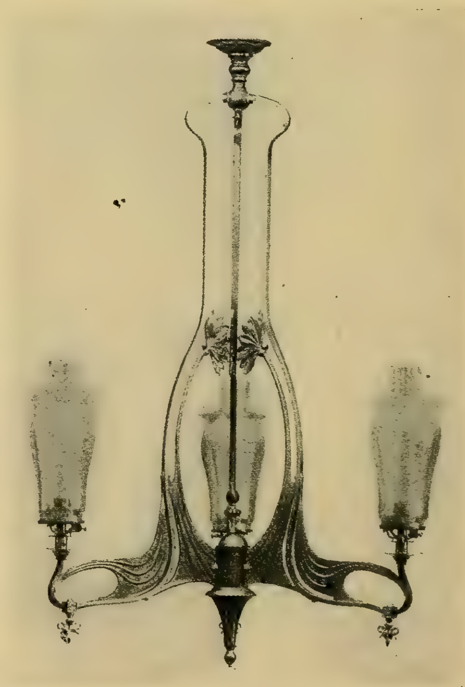
A SIMPLE, BUT PLEASING DESIGN FOR UPRIGHT MANTLE BURNERS.



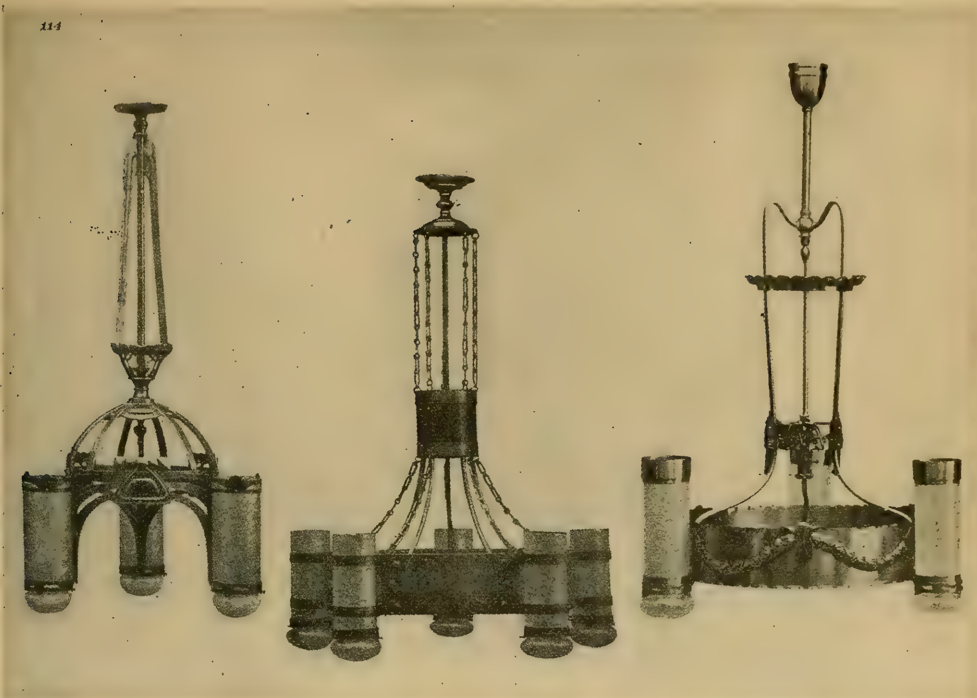
A GERMAN ART NOUVEAU DESIGN FOR UPRIGHT MANTLE BURNERS.



A COMBINATION OF BOWL AND INVERTED BURNERS, OF GERMAN DESIGN.



ANOTHER EXAMPLE OF GERMAN DESIGN FOR UPRIGHT BURNERS.




SOME ORIGINAL AND STRIKING EFFECTS THAT ARE CHARACTERISTICALLY TEUTONIC.

reasons for its existence, and it has no need to make excuses by posing as an imitation. It is quite as susceptible of artistic treatment as the electric lamp, and the quality of its light is every whit as good.

The American manufacturer has apparently ceased to devote his constructive and creative abilities to the design of fixtures for gas illumination. As examples of American ideas therefore, either the fixtures that were designed years ago must be taken, or electrical fixtures which, by simple changes, could be adapted to gas lighting. In Europe the conditions are quite different. Gas lighting is still a subject for the best efforts of the fixture designer, and the prevailing ideas of decorative art as applied to fixture construction are found exemplified quite as much in gas fixtures as in electric. As we have stated before, the Art Nouveau school of decorative art apparently dominates the entire field in Europe at the present time, showing its influence in wall papers, carpets, tapestries, jewelry, in fact all articles which are subject to decorative treatment. Among the designs of lighting fixtures almost no other school of art is shown. The examples illustrated are taken from the catalogues of English and German manufacturers, and will give some idea of the lines along which foreign designers are working. Whether or not this school of design will become generally popular in this country remains to be seen. So long as the present tendency toward "period" furnishing continues it is obvious that all forms of new art will be held in abeyance. The motifs of this new school of art are so different from what we have been accustomed to that in many respects it appears strange, and possibly uncouth; but, like fashions in dress, familiarity soon removes such conceptions.

# Symbolism and Art

By Bassett Jones, Jr.

In the paper on "Church Lighting" read before the Philadelphia section of the Illuminating Engineering Society on April 24th, 1908, Mr. Emile G. Perrot makes some remarks on the symbolism of art that require some further examination and explanation. In the form in which they are given these remarks may be quite misleading as to the true meaning and value of the term.

We may first ask ourselves what a symbol is. Symbols are forms or objects that stand as representing other forms, objects, meanings or ideas. As such, we may classify symbols as: Substitutive symbols, suggestive symbols, and expressive symbols. Substitutive symbols are used to economize thought and the attention is fixed on the sign and not on what it expresses. Such symbols are the signs of mathematics. Suggestive symbols are of the most rudimentary description and serve to arouse the memory through association. A string tied about the finger to remind one of an errand to be done is a good example of the suggestive symbol. In expressive symbols, on the other hand, the attention is not fixed on the sign, but upon what it expresses. Words are good examples of expressive symbols, for here we find, as Mr. Perrot points out, that it is what the symbol expresses that occupies the attention of the reader and not the sign itself. But more than this, the expressive sign can be taken by itself if its full intent is to be developed. The environment or context of the expressive symbol is an essential factor in its meaning. Thus the word "water" alone is the barest of abstractions, and conveys little if any impression of the real meaning intended unless we try to understand the purpose with which it was spoken or written. We cannot agree beforehand upon any more meaning for the word than that it shall represent the simple element. The qualitative and quantitative meanings which give it a linguistic value are left for the other forms of expression to convey. How different the meaning of the word when uttered by the lips of the traveller who, lost in the unexplored wilderness first views the distant sea from some barren hill-top, and when gasped with the last breath of the dying soldier!

Or, in the case of the visual sign, what similarity is there between the meaning of the Egyptian's hieroglyphic and the mad swirl and rush of Turner's "Tempest"? As for the first we can say without fear of contradiction that it acquires such direct meaning as it possesses through previous agreement on the part of those concerned, but who shall we say agreed beforehand to acknowledge the latter as in any sense representing water as such? Certainly no one earlier than Turner ventured to express the form of water in a similar way, and no one has since possessed the ability to imitate his methods.

It is a common error to imagine that art seeks to represent nature—to copy it with all due regard to detail—and to symbolize it with the intention that the physical reality shall be represented in acceptable form. Yet, if such were the case, how inadequate and futile must all art be when compared to its supposed original! If art is a symbol for reality then by all means let us have the reality for it must be infinitely more perfect and complete. The facts, however, remain, that no natural landscape is half so perfect as a "Constable"; that no "real" language is half so expressive as Hamlet's; that no natural formation is half so grand as Durham, and that no human form is half so graceful as Psyche's.

Of course we do not believe that Mr. Perrot intended to express any such crass and unreflective realism as the above. He undoubtedly means that the reality symbolized by art is the reality of ideals. But the question may be asked, which is the symbol and which is the art? Are the written musical symbols in themselves art, or, is the art itself the thing that is symbolized? Surely, if it is sufficient to define art as symbolic representation of reality, then, since such symbols are certainly to be classed as expressive, what distinction can we draw between the art of Keats and the dullest prose, or between the printed score of a Beethoven symphony and the

tame and hopeless page of the latest popular song? In either case the symbols, as symbols, may be equally good in one as in the other, so that the distinction must be naturally drawn altogether outside of the symbols, and is a matter of comparison between what the symbols stand for and not a matter of comparison of symbols. Art, to anticipate, is not a case of symbolic representation of reality; it is reality itself. The art of music lies not in the printed page, but in the expressive concordance of sounds; the art of poetry lies not in the printed words but in the expressive concordance of meanings; the art of the painter lies not in his ability to abbreviate nature, but in his power to see in nature a certain expressiveness which he seeks to interpret into a concordance of sensations aroused by harmonious arrangements of colors and lines. Nor does art "stand for" this expressiveness. It is the expression itself interpreted to sense through the mediums of sense. Art is no more symbolic of reality than a translation of a work in a foreign language is symbolic of the original.

This question of Symbolism in Art has been so thoroughly thrashed out and disposed of since the days of Aristotle that it seems almost impossible that it should still be held as an adequate definition. Yet it is in a large measure just this fact that stands in the way of the appreciation of the best in art. Quite the reverse to Mr. Perrot's statement, we may say that if art is taken to be a symbol of reality its truth as a means of expression must forever remain a hopeless enigma. That there is a symbolic form of early art, so-called, is true, but this art is the result not of expression, but just of the lack of ability in the artist to find adequate expression for his ideals, or rather it is due to the fact that the ideal has not so shaped itself that it is capable of concrete embodiment. The ideal has, so to speak, not yet found itself, and such art remains crude in meaning, although often grand through the expression of the mental struggle in which it had its origin.

We have said that art is reality and this statement requires some further elucidation. We may distinguish in experience two orders of facts to which we attribute the characters of actuality, reality, and truth. These are the world of inner experience—the world of sense, feeling and ideas—and the world of outer experience—the world of matter. We are prone to give the common title of reality with some emphasis to the latter because we find that the "things" of the outer world possess an apparent fixedness and independence of the objects of the inner world. Yet we may point out that while the "things" of the outer world are in truth real, yet their reality in the popular sense is primarily presented to us as a chaos of accidental forms and behavior, into which we read some semblance of order only through the operations of the inner world of ideas. The outer world only becomes a known world as it becomes for us a world of objects for thought, and thus the distinction between inner and outer is seen to fall within the known world—within the known world of ideas and facts—and not between this world and some other unknown world. The essential reality of this world then does not reside in the mere compelling contact of the outer with the inner, but is due to the common idealization of both its aspects. Indeed, from one point of view, we may say that we live only by the power which ideas possess to compel the outer world to fulfill the ends of purpose.

The fact that the outer world does present to us the means for the fulfillment of the meaning of ideas gives it an import or value that it would not otherwise possess. The facts of outer world then are not ultimate things, but elements in a larger whole of ideas. And this unity is presented to us not in the immediate contact of "things" but as a form of experience the reality of which is immediate and absolute.

It is this reality—the reality of the ideal experience—that art seeks to present in a characteristic form of expressiveness. And it presents this experience not through the medium of symbols, but directly through the same channels through which all experience is presented, namely the channels of sense

# Theory and Technology

## The Spherical Candle vs. The Lumen

By Carl Hering.

The advantages of using the quantity called flux of light, in photometric calculations, as recommended many years ago by that able pioneer Blondel, are being more generally recognized. As long ago as 12 years, the use of this quantity in numerical calculations was emphasized to the world by the excellent and very creditable work of the Geneva Congress or Conference, which established a uniform and rational system of units, definitions, and terms. This Congress did not have as official a standing as some other international meetings did, because some countries did not participate; and its conclusions were not adopted by subsequent congresses, probably because there was some hesitancy about fixing the numerical value of the unit of intensity (candle) at that time; this unit is the basis of that system, the others being defined in terms of it, hence its numerical value was necessary for fixing the numerical values of the others. But the system of units as a system, independent of their numerical values, can be considered by itself, and when thus considered, the result of that congress was unquestionably a very valuable and creditable piece of work, even though all nations were not represented. The writer has criticized* one feature in this system but it is a minor one and does not affect its main features. In this Geneva system of units, the importance of flux was pointed out, the unit was named the lumen, and was made equal to one unit of intensity multiplied by one absolute unit solid angle, or to one unit of "illumination" multiplied by one unit of surface; both definitions amount to the same thing in that particular system because it is based on the absolute unit of solid angle.

In this country the same name lumen has recently come into use, but not with the same numerical values. It is somewhat as though we had adopted the foreigner's meter here but had made its value equal to our yard, in which case we would have to distinguish between our meter and the original meter used abroad. But the difference in the case of the two lumens is small, and as the intensity is the fundamental quantity in this system, while the lumen is derived from it, it is not unreasonable for us to define our lumen in terms of our candle, especially as the unit of intensity unfortunately still differs in its numerical value in different countries, and as long as it does, there is no good reason why the lumen should not differ in the same way. Hence, in the opinion of the writer, it is not improper for us to define our lumen in the way we do, provided it is clearly understood that its numerical value differs in the same way from its value in other countries where it originated, as our standard candle differs from their respective standards of intensity. The more important of these differences is the one existing between our lumen and that based on the hefner unit; the numerical relations between these two

* Elec. World, Sept. 26, 1908, p. 673.

lumens are:

our lumens=lumens based on hefner × 0.88

The much smaller difference between our lumens and those in France and England may not exist much longer.

Since the recent more general introduction of the lumen in this country, the question has arisen whether the well known quantity called a spherical candle is also a correct measure of flux; and if so, whether there are any advantages in using it besides the lumen.

Considering the last point first, it is like using both the gallon and the cubic yard as measures of volumes. There is no reason why the railroad engineer could not measure his earth works in gallons and the wine merchant measure his beverages in cubic yards, but they would no doubt both object to abandoning the unit best adapted to their needs. Hence the retention of both the liter and the cubic meter in the metric system. A more direct analogy is our method of measuring plane angles; we use the circle as the unit when we speak of simple fractions of it like the semicircle, and the quadrant, and we use degrees as the unit for other than these simple fractions. There seems to be no good reason why the existence of this very useful unit called a degree, should bar us from using the whole circle or simple fractions of it, whenever it is more convenient to do so. The spherical candle as a measure is quite analogous to the circle and the lumen to the degree, or still more directly to a third angular unit called the radian which is very seldom used.

A spherical candle, as its name implies, is the radiation from a candle throughout a whole sphere, and a hemispherical candle the radiation throughout a hemisphere; the flux in the latter case is, of course, half that in the former. The term "candle" is the same in both, but the solid angle is only half as great in the latter. The terms "spherical" and "hemispherical" therefore apply to the respective solid angles in the well known formula:

flux=candles × solid angle.

or in other words, the unit solid angle is here taken as the whole sphere, any other angles being expressed in fractions of a sphere, just as was cited above for plane angles expressed in fractions of a circle. Spherical candles therefore represent the product of an intensity (candles) and a solid angle, and they consequently measure flux in terms of the whole sphere as the unit, while lumens measure it in terms of the absolute unit solid angle (the steradian); this is the only difference between them. To reduce one to the other, therefore requires multiplying or dividing by the factor $4\pi$, because there are $4\pi$ or about 12½ absolute units solid angle in a whole sphere, just as there are 360 degrees or $2\pi$ radians in one whole circle.

It follows from this that whenever the flux from a point source is to be calculated for the whole sphere or for any simple fraction of it like a hemisphere, it is much simpler to use the spherical candle as the unit of flux instead of the lumen, as one then does not have to multiply by the troublesome factor $\pi$. In fact this is what we have been doing (perhaps unconsciously) for years before the introduction of the lumen, when we spoke of spherical and hemispherical candles; it was not then called flux, although it really was a measure of flux. And we are still using the spherical candle as a measure of flux, although often unconsciously, in the very common expression for the so-called "efficiency" in watts per candle, (by which, of course, is meant the spherical or hemispherical candle,) because an efficiency must always be the quotient of two like quantities, hence spherical candles must be the same kind of a quantity as watts, and watts (power) are quantities of the same kind as lumens. It would be violating one of the first principles of mathematical physics to calculate an "efficiency" from two physically unlike quantities.

Moreover this expression could not have meant anything else, because a relation between watts and candles as such (that is, intensity, or flux density) would be physically absurd, meaningless, and useless, as one watt can generate any number of candles in the same lamp by simply condensing the beam of light more or less; such a relation must therefore include the size of the angle through which this intensity is radiated; hence to have any rational meaning, some angle must be implied or stated; this angle is the sphere or the hemisphere as the name shows. Hence the

term spherical or hemispherical candle must be understood to include the angle in order that the well-known expression watts per spherical candle has a rational physical meaning; a spherical candle must therefore be and always has been a true measure of flux.

To abandon the use of the spherical candle as a unit of flux in favor of the lumen, would therefore be to abandon that most common of all photometric relations, watts per candle; in the opinion of the writer an attempt to do this would not only be hopeless, but even very unwise, as it would necessitate multiplying by the troublesome $4\pi$ every time we wish to state this very common relation, the so-called efficiency, while now we only multiply by unity, because the flux stated in spherical candles is numerically the same as the candles, for the whole sphere, which is now the unit solid angle. It would involve an enormous amount of calculation to always have to divide or multiply by $4\pi$ in order to give this very common figure in other terms than spherical candles, because in by far the majority of cases, the flux refers to either the whole sphere or to a hemisphere, and for these the lumen is an awkward unit to use on account of this $4\pi$. Any attempt to abandon the spherical candle as a unit of flux, would therefore greatly increase mathematical calculations, where they are now the ideal of simplicity and would unquestionably meet with a storm of disapproval from those who realize what it would mean.

In some other calculations, on the other hand, the lumen is the simpler unit to use; and in still others the $\pi$ factor must be used no matter which unit is chosen. Hence in the writer's opinion the wisest plan is to retain both units and use that one which is the most convenient in the particular case, just as was done with the gallon and cubic yard, the circle and degree (or radian), the liter and cubic meter, the watt hour and coulomb, the horse-power and the kilowatt, the dyne and the gram as forces, etc.; there is no lack of precedence for doing so. Numerical calculations must necessarily always give the same result whether the one or the other or both are used; this, it is believed, is not questioned. In a recent paper before the Illuminating Engineering Society, the writer has given a collection of formulas in which all those involving flux are given in terms of both units, so that the one which is simplest for any particular case may be readily selected.

Another physical proof that spherical candles are true measures of flux, is the well-known relation

$$\text{lumens} = 4\pi \text{ spherical candles.}$$

In this the factor $4\pi$ is a mere number or ratio and therefore has no physical dimensions. But according to a well-known principle in physics, the physical character of a quantity cannot be changed by multiplying it by a mere number; hence if this relation is a correct and complete equation, as it seems to be, the two quantities lumens and spherical candles must be of the same kind physically, that is they must have the same dimensions and are therefore both flux. This and the other proofs given above, seem to show that this is a matter of fact and not of opinion.

Another very good reason for retaining the spherical candle as a unit of flux, is, that it is a well-known and much used term, while the lumen is a new and less familiar one, which many would no doubt hesitate to use until they are accustomed to it. Hence a gradual change from the one to the other would seem to be preferable to a sudden one.

In the writer's opinion we should always act in accord with the Bureau of Standards at Washington in all matters concerning the numerical value of units in other countries, and, in this connection, it may be of interest to state here that while this Bureau has in no sense adopted any specific unit of light flux, it has been its custom in measuring light to use the lumen, taken, however, in terms of the candle maintained at that Bureau instead of in terms of the hefner as originally defined by the Geneva Congress.

# Recent Progress in the Voltaic Arc

(CONTINUED.)

BY ISIDOR LADOFF.

Subsequently to German patent 114242 of Sept. 25th, 1899, claims carbon pencils containing not less than 3 per cent of an addition having in view a favorable modification of the slags. A German patent, 118867, of Oct., 1899, claims a flux composed of Silicates Nacl, No2, Co3, K2Co3, Tio2, tartaric acid, etc. As can readily be seen the Bremer electrodes were rather complex in their composition and essentially did not represent anything new. None of the defects of the mineralized pencils of his processes were removed. What was new in Bremer's lamp was its mechanical features, with which we have here nothing to do.

Bremer's carbons revealed the fact that the metallic fluorine salts used by him are not decomposed in the arc or if they are decomposed, combine again.

The following table elucidates the effects of the addition of various proportions of chemicals on the voltage and amperage of the arc and light efficiency:

| N. N | Chemical | Quantity in per cent. | Voltage | Amperage | Photometric Indication | Relative Specific Light Efficiency |
|---|---|---|---|---|---|---|
| 1 | CaO | 2.5 | 44.5 | 8.02 | 221.1 | 136 |
| 2 | " | 5.0 | 45.5 | 7.95 | 235.1 | 184 |
| 3 | " | 9.9 | 44.6 | 7.95 | 226.3 | 153 |
| 4 | Ca $F_2$ | 2.6 | 45.0 | 7.95 | 232.9 | 174 |
| 5 | " | 4.95 | 44.2 | 8.00 | 241.5 | 212 |
| 6 | " | 10.2 | 45.0 | 8.00 | 273.6 | 435 |
| 7 | MgO | 2.6 | 44.9 | 7.94 | 191.4 | 71.8 |
| 8 | " | 5.0 | 44.5 | 7.99 | 200.4 | 87.6 |
| 9 | " | 10.0 | 44.1 | 7.99 | 185.4 | 63.8 |
| 10 | Mg $F_2$ | 2.6 | 44.8 | 7.97 | 200.3 | 86.6 |
| 11 | " | 5.1 | 44.2 | 8.01 | 215.9 | 122.0 |
| 12 | " | 10.0 | 45.2 | 7.96 | 201.9 | 89.6 |

The figures in the last column are relative values per watt not recalculated to C. P. as we are only concerned here with comparative data. The advantages of fluorides over oxides are rather marked. As to the belative value of fluorides of the same metals the following table will enlighten us:

| N. N. | Chemical | Quantity added in per cent. | Amperes | Volts | Photometric Indications | Relative Specific Light Efficiency | Notes |
|---|---|---|---|---|---|---|---|
| 1 | CaO | 2.5 | 8.01 | 44.1 | 213.0 | 114 | |
| 2 | " | 5.0 | 7.93 | 45.4 | 219.3 | 127 | |
| 3 | " | 9.9 | 7.98 | 45.7 | 279.6 | 127 | |
| 4 | $CaF_2$ | 2.6 | 7.97 | 45.8 | 231.7 | 164 | |
| 5 | " | 4.95 | 8.00 | 45.4 | 244.4 | 218 | |
| 6 | " | 10.2 | 7.91 | 45.7 | 268.1 | 374 | |
| 7 | " | 3.7 | 7.96 | 44.8 | 235.8 | 184 | 2.6% Cao corresponds to 3.7% Ca $F_2$ when the contents of Ca is equal in both compounds. |
| 8 | CaO | 2.5 | 7.97 | 44.7 | 217.8 | 125 | |
| 9 | $CaF_2$ | 6.8 | 7.88 | 44.9 | 242.9 | 216 | 4.9% CaO corresponds to 6.8% $CaFe_2$ when the quantity of Ca is the same in both cases. |

| N. N. | Chemical | Quantity added in per cent. | Amperes | Volts | Photometric Indications | Relative Specific Light Efficiency | Notes |
|---|---|---|---|---|---|---|---|
| 10 | CaO | 5.0 | 7.97 | 43.5 | 224.3 | 147 | |
| 11 | $CaF_2$ | 14.3 | 7.93 | 44.7 | 247.7 | 239 | 10% of Ca is equivalent to 143.3 % $CaFe_2$ when the equivalent Ca is the same in both chemicals. |
| 12 | CaO | 9.9 | 7.94 | 4.41 | 218.5 | 129 | |

The influence of the contents of fluorine when the quantity of metal in the com-

pound is identical can be seen from experiments 7 and 8, to be 7.4 : 5.0, from experiments 9 and 10, 7.3 : 4.9 and from experiments 11 and 12, 9.25 : 5 in favor of the fluorides.

The following table proves the importance of fluorine compounds in the mineralized pencils.

| Chemical | Quantity added in per cent. | Voltage | Amperage | Photometric Indications | Relative Specific Light Intensity |
|---|---|---|---|---|---|
| CaO | 2.5 | 44.3 | 7.93 | 220.9 | 135 |
| " | 5.0 | 44.2 | 7.92 | 232.2 | 172 |
| " | 9.9 | Not measurable on account of excessive flagging. | | | |
| C-$F_2$ | 2.6 | 43.8 | 8.00 | 242.5 | 216 |
| " | 4.95 | 44.5 | 7.89 | 258.9 | 311 |
| " | 10.2 | 45.3 | 7.88 | 270.0 | 396 |

The influence of the fluorides consists probably in their action as fluxes on the other mineral constituents of the carbons. The success of Bremer invited other inventors into the field of mineralized pencils. E. Raasch stepped forward in 1892 with propositions for Electro-Bengalic arc light electrodes. All known and many small concerns manufacturing arc lamps and carbon electrodes entered into the field of mineralized carbons and flaming arc lamps flooded the market.

The General Electric Co. (German patent 134732 of Aug. 8, 1900) claims the use of waterfree halogen salts, silicates along with CaF2. The metallic compounds selected according to their spectra are claimed not to attack the glass globes of lamps. Siemens Bros. & Co. (German patent 144463 of Oct. 13, 1900) monopolize the Nitrides of the rare earths on account of their high resistivity to heat and high contents of metals. Herman J. Keyster (German patent 137809 of Oct. 6th, 1901 and 138467 of Sept. 8, 1901, also 141734 of Oct. 20, 1901) recommend the use of carbides of metals. In order to protect from decomposition carbides unstable in the presence of moisture it was advised to use hygroscopic materials in a special receptable near the arc and also to enamel the electrodes with a waterproof compound. C. R. Boehm of Charlottenburg suggested in 1902 for a coring material a conglomeration of one part of finely pulverized Na 1 Ca and Mg fluorides with one part of carbon powder with some binder in the shape of a paste which, with eventual addition of a silicate, is squirted into the core. The Magnesium fluoride is dissociated in the arc and the freed metallic magnesium reduces the other salts, so that the spectrum of their metals appear in the arc ) ?( The quantity of the fluorides to be used is determined in accordance with their equivalent weights. The Union Electric Co., (German patent 149718 of Sept. 10, 1902) claims an electrode with two mantles of which one is melting at a low temperature and volatilizes readily (the inner mantel) and the other is composed of refactory substances of high melting and vaporization points (outer mantle). The latter contains oxides of comparative low conductivity. Mr. Lilienfield (German patent 153085 of Oct. 23, 1902) adds the minerals to the binder (tar or pitch) previous to the addition of the carbon, in order to avoid loss of the light giving substances. Robert Hopfeld (German patent 150687 of Jan. 14, 1903) heats the cored pencils at a temperature not higher than 450 degrees C. for the same purpose. Bros. Siemens Co. (German patent 152833 of Jan. 14, 1902) use Magnesium fluoride and other salts in quanities corresponding to their atomic weights. As the mineralization of the carbon pencils increases their electric resistance, it was considered ?

tance, it was considered useful to counteract this tendency by incorporating into the core metallic wires. Another way of attaining the same result is the use of compensating resistances in the lamp so as to keep the arc tension approximately constant (German patent 148880 May 10, 1903) and (151509 of June 18, 1903. In order to reduce the formation of slags without the corresponding dimution of the quantity of minerals in the carbons (German patent 147724 of Mar. 28, 1903) proposes to raise the temperature. This is claimed to be accomplished by the introduction of $KNo_3$, $KClo_3$, $BaO_2$ and similar substances into cores symmetrical with the axis of the pencil and in their total area equal to ½ of the crosscut of the pencil.

*(Continued in next issue.)*


## The Second Annual Convention of the Illuminating Engineering Society

The event of the year in the calendar of illuminating engineering was carried out with the most eminent success in Philadelphia, during Monday and Tuesday, the fifth and sixth of this month. Two hundred forty-seven members of the society registered their attendance, together with one hundred fifty-seven visitors. The membership of the society at the present time is nine hundred ninety-two. When it is considered that the society is national in its scope, and that its members are scattered from the Pacific coast to the Atlantic, the proportion of attendance at the convention will be seen to be extremely gratifying.

The program of papers would have been a credit to any scientific society. They were generally short, and contained an unusual amount of original matter. Both the papers and the discussion will form a prominent and valuable addition to the literature of illuminating engineering. The number of papers which were reports of original investigations undertaken for the special purpose of establishing the facts in regard to matters that were either imperfectly understood, or upon which no authoritative data was obtainable, formed a considerable portion of the whole number presented. It is papers of this kind which show the actual value of the society, and establish it upon a permanent foundation. There are many interesting but minor matters of fact and opinion which are proper subjects for the consideration of the several sections at their regular meetings; but the convention papers should deal with the fundamentals of the subject, and so far as possible with the results of research.

A distinct gain in the value of the convention was the method of presenting the papers in abstract, instead of having them read in full, a plan which we urgently suggested sometime ago. This gave the majority of the time for their discussion, which proved still too short to bring out all that the members had to say.

The entertainment committee must certainly be congratulated upon the success of their part of the convention, and as one of the visiting members aptly remarked, "Philadelphia has forever absolved itself from the indictment of being 'slow'."

A new feature, and one much to be commended, was the exhibit that was shown during the convention. While the space available for this was comparatively small, and the exhibits in point of number not numerous, they were exceedingly instructive and admirably arranged. Furthermore, the exhibit was entirely free from any commercial or advertising feature. We do not recall ever having seen condensed into so compact a form so many items of educational value and historical interest. The spectator who would have seen and understood each of the exhibits shown would have had a fairly comprehensive knowledge of the technology of illumination. Practically every commercial light-source was shown, and in many cases their evolution as well. The effect of the different light-sources on color was also admirably demonstrated. The various instruments for measuring light were likewise shown. For the success of this admirable exhibition the committee,

headed by Mr. J. B. Clumpp, is deserving of all praise.

All told, the convention was an unqualified success. It did not place illuminating engineering on an established basis, for this had already been accomplished more than a year before; it strengthened this foundation, and raised the super-structure another full story.

## The Meaning of Photmetric Units

One of the most important papers presented to the convention was that of Mr. Carl Hering, which treated of the meaning and mathematical relation of the various photometric units and quantities at present in use throughout the world. The paper was profusely an attempt to clear up some of the "mistiness" that overhangs this important part of the illuminating engineering field. That such mistiness prevails is a fact only too evident to both the beginner of the science and the most technically trained practitioner. No better evidence of this is wanted than the fact that Dr. Sharp, who has spent years of study in the line of photometry, and who should be qualified to speak, flatly denies the correctness of the definition of one of the fundamental units of photometry as set forth by Mr. Hering, who is equally well qualified to pass upon such matters. We may expect doctors to disagree on matters of opinion and minor details, but that two equally well known and authoritative doctors should radically disagree upon the fundamental units of the science is a painful demonstration of the inadequacy and ambiguity which runs through the whole terminology of the mensuration of light.

To be specific, Mr. Hering gives mean spherical candle power as a measurement of flux of light using one spherical candle as a unit, while Dr. Sharp declares that spherical candle power is not a measure of flux at all, but of intensity. The numerous units at present in use in the different countries of the world in the science of photometry are a result of the earlier and cruder stages of evolution of the science, and not only vary in the different countries, but exhibit the same kind of crudities that still persist in the English system of weights and measures. The great pity is that these units and terms have been sufficiently long used to gain the authority to custom, and against that authority it is almost useless to appeal,—as witness the attempts to introduce the metric system in this country. The sooner the present misleading and misunderstood terms are corrected the better it will be for the progress of the science. The great desideratum is prompt action, for the use of the terms is rapidly increasing, and custom is being strengthened at the same pace. In regard to several of the units it is extremely doubtful if a change could be made. The most successful results will undoubtedly be obtained along the line of compromise and of fixing definite meanings to terms already in use, rather than in the establishment of new ones.

As to the meaning of the term spherical candle-power, which developed such radical difference of opinion, it seems to us that it is one of the terms to which custom has already fixed a meaning that is generally understood and likely to prevail. From the purely theoretical stand-point mean spherical candle power will be found at the least analysis to represent intensity of rays, or, as Mr. Hering puts it, "flux density"; but since the entire flux, or quantity of light, emitted from a light-source is directly proportionate to the average intensity or "flux density" of the rays in all directions, such intensity may be taken as a measure of the total flux of light, and this is the sense in which the term has been commonly understood, and is commonly understood at the present time. Thus, two light sources of respectively eight and sixteen mean spherical candle-power give out quantities of light (flux) in the ratio of eight to sixteen. It is entirely logical, therefore, to consider one spherical candle as a unit of quantity, or flux of light. To deny this and insist on restricting the meaning of the term to the purely mathematical basis is to add confusion to a matter that is beginning to clear itself up. Flux, or quantity of light, involves two quantities in its measurement, in other words, must be measured by a derived unit. In using derived units it is not customary to state the quantities involved; as for example, horse-power, which involves force, distance and time. So in the term, mean

spherical candle-power, the only qualification necessary to give it absolutely the same significance as the lumen is to understand that spheres of unit radius are used. Furthermore, taking the candle-power as a unit of measurement of intensity, the spherical candle-power is as logical and scientific a unit as the lumen, and as Mr. Hering points out, for many purposes, is much more convenient to use. To deny its legitimacy, or to cast doubt upon its scientific accuracy is a step backward in the urgently needed efforts to clear up the mists that have too long befogged the understanding of photometric terms.

## The Third Annual Meeting of the American Gas Institute

This meeting will be held in New York, October 21, 22 and 23. A comprehensive list of papers has been prepared, and a considerable number of reports of committees will also be presented. The attractive entertainment program for ladies and visitors includes a banquet at the Hotel Astor; a theatre party to the Hippodrome, an automobile trip around New York, and an excursion up the Hudson to West Point.

The majority of papers are on subjects involving gas engineering and technology. In the field of illuminating engineering a paper will be presented by Mr. Thomas J. Little, Jr., on "Better Gas Illumination", and a paper by Mr. Charles O. Bond on "Some Further Remarks on the Photometry of Gas." The Committee on the Unit of Light will also report through its chairman, Mr. W. H. Gartley.

The importance of the work which may be accomplished by the American Gas Institute need not be enlarged upon here. What may be accomplished by thorough organization and enthusiastic co-operation has been sufficiently demonstrated by the National Electric Light Association and other similar organizations. It is "up to" the Gas Institute to demonstrate that it is as keenly alive to the possibilities for advancing the interests of its members, and as aggressive and progressive in working to this end as are its sister associations.

## Fake Illuminating Engineering

There is a period in the evolution of every branch of science or discovery in which only the results are known to the public, which by reason of ignorance as to the cause, possess more or less the character of mysteries. As ignorance is the trading stock of the commercial fakir and charlatan, such periods are always marked by the use of the terminology of the science as a mask for fraud.

Electricity has been probably the most fruitful source of such faking of any of the great branches of natural science; and general knowledge upon this subject is not yet sufficient to put these frauds out of business. Electric belts and hair brushes, magnetic insoles, and numerous other like articles are still sold by the thousand. There is nothing easier to juggle with than light, and light from electricity furnishes a combination which it would be hard to beat for the purposes of the commercial fakir.

Illuminating engineering is a new, strange, and high-sounding term, and consequently offers an enticing field for the charlatan; a field that is by no means being left uncultivated. In a few cases it has been used for purposes that are essentially crooked, and intended to deceive; in other cases it has simply been used as a cat's paw with which the salesman for some particular kind of lighting device might pull his chestnuts out of the fire.

Mr. Norman Macbeth, who is familar to our readers through his frequent contributions to the pages of The Illuminating Engineer, has a very vigorous and characteristically outspoken article in a recent issue of the "Dry Goods Economist," in which he touches upon a number of vagaries of the present day illuminating engineering—"as she is engineered." Mr. Macbeth enjoys the distinction of being absolutely independent, and free from all entangling alliances. Furthermore, like Lawson, he "knows the game," from the innermost secrets of the meter and the lighting contract to the photometric measurements of illuminating results.

In the case of gas it is simply a case of so much per thousand feet, with practically no opportunities for befuddling the user as to the amount of his bill; but the electric contract is quite different, and is

not always drawn so that "he who runs may read," but rather that "he who reads may run," either to the company with a vigorous kick, or away from the electric light all together. After the illuminating engineer has performed his work conscientiously and successfully, it may happen, as Mr. Macbeth points out, that the saving effected goes into the lighting company's till instead of that of his client. This is a short sighted policy, and bound to react against the lighting company sooner or later. We know a case where a customer, towards the end of the month, had to run all the lights twenty-four hours a day in order to reduce the lighting bill. It is such palpable absurdities as this that have been largely responsible for the creation of public utility commissions. Laws are made necessary by those disposed to be lawless.

Mr. Macbeth pays his respects to the "salesman illuminating engineer".

He then describes the "reflector illuminating engineer,"— the man who puts in a four candle-power lamp with a concentrating reflector in place of sixteen, and pockets half the difference in the cost of current. This kind of fakir we fully exposed in one of the early issues of THE ILLUMINATING ENGINEER, and happily his race is nearly run.

Again, "there is the illuminating engineer who sells scientifically designed fixtures, and who rarely considers the problem of proper installation and the result of illumination,—his business being to exploit scientific fixtures and secure orders for the factory."

Finally, Mr. Macbeth likens the illuminating engineer to a physician "whose advice you seek when your body requires looking over; you are not as likely to go to a druggist and accept patent medicine as formerly." He might also have added that, at the present time, the professional illuminating engineer is an unlicensed practitioner who has assumed his title without leave of the law or benefit of the clergy, and may be practicing in more senses than one. He may base his title upon membership in The Illuminating Engineering Society, which means that he is interested in the subject of illumination, at least to the extent of a $5.00 initiation fee. This society was rightly started on the broadest possible lines, but the time must soon arrive, if it is not already at hand, when it will become necessary to draw a line between the qualified illuminating engineer and the mere student, or amateur of the subject. Illuminating engineering is an exact and legitimate branch of applied science, and in every way worthy of a place among the several branches of engineering; but if it is to hold the respect due to such a branch of learning, it must see that its good name is not brought into disrepute by being used simply to exploit particular lighting devices or personal and commercial ends.

## Illuminating Engineering as an Art

The basis of all engineering is economy, the achievement of a material result with the least amount of material. Illuminating engineering had its origin in a very legitimate desire to prevent the needless and excessive waste of light. It is not at all strange therefore, that in the pursuance of this aim the apparently subsidiary question of "looks" should have been given little consideration. The comparatively easy task of improving efficiency, i. e., of securing results with greater economy, and the very striking results obtained, have perhaps unduly elated the practicing illuminating engineer and given him a distorted view of his profession. Illuminating engineering differs from other branches of engineering in being intimately and unavoidably connected with what may be termed "applied art."

It is not sufficient that a building afford shelter,—a cave will do that; it must satisfy a demand that is equally urgent, namely, the appreciation of beauty, using the word in its broadest and most scientific sense.

A lighting installation must, of course, furnish illumination; but the most successful accomplishment of this end does not give it any license to offend the eye by transgressing the idea of the beautiful. It is along these lines that the illuminating engineer and architect have clashed. It was simply a case of the meeting of extremes. The architect saw only the artistic side, the illuminating engineer only the economical side. Com-

plete success can result only by a proper combination of the two. A sheep-skin garment would keep out the cold quite as well as seal-skin, but that argument will never convince the majority of feminine humanity that they should wear sheep-skin coats, and in fact why should they, if they have the price of a seal-skin coat, and the latter pleases them better? Some lighting accessories admittedly waste three-quarters of the light; but if the user is aware of the fact, and is entirely willing to pay for this waste for the sake of satisfying his aesthetic taste, who shall say him nay?.

Illuminating engineers must carefully distinguish between the intelligent selection of lighting apparatus for artistic effects, which is entirely legitimate and beyond their jurisdiction, and the waste of light through ignorance of the devices used. When the illuminating engineer has fully acquainted his client with the efficiency or inefficiency of any particular scheme or method of illumination, and told him how much light must be generated to secure the requisite illumination by the use of any particular fixture or device, he has gone the limit of his prerogatives. Efficiency alone is by no means the only thing to be attained in a lighting installation; artistic effects may be in many cases equally important.

The architect, by virtue of his profession, assumes full authority in regard to the artistic phases of the question, and keenly and often strenuously resents the slightest interference in this regard. He assumes that the illuminating engineer is, by virtue of being an engineer, entirely incompetent to pass upon any artistic problem. Doubtless it is within the architect's "sphere of influence" to handle all artistic problems, since he is held responsible for the completed building as a whole; and there is no particular reason why the illuminating engineer should wish to interfere, except in the case where he plainly sees that the fundamental purpose of producing adequate illumination is going to be frustrated.

There is, however, no inherent reason why the illuminating engineer should not be an entirely competent judge of the artistic merits of a lighting installation; but this would necessarily require at least as much study of applied art with reference to building as would be necessary were he to become an architect instead of an engineer. The design of fixtures is very commonly handed over to the fixture manufacturer, who, working under the general directions of the architect, produces the necessary designs. A combination of illuminating engineer and fixture manufacturer is therefore a legitimate and a good one, as we have already pointed out.

It is not strictly within the province of the illuminating engineer to design or pass upon the artistic side of fixtures, and there is absolutely no excuse or justification for his specifying or interfering in the least with this side of the problem unless he is called upon to do so, or has, by an equivalent course of training, made himself competent to do so. He must get it out of his head, however, and the sooner the better, that the mere production of illumination is always the sole end of a lighting installation.

On the other hand, the architect must understand that needless waste of light cannot be justified on any grounds. Needless waste of light means more than is required to produce the results which the architect requires, and this includes both the artistic and the utilitarian results. The illuminating engineer is an assistant to the architect, not an obstructionist. The ideal conditions would include the mutual and hearty co-operation of architect, fixture manufacturer, and illuminating engineer.

## Errata

In the article by Mr. Carl Hering in the September issue, page 382, 4th line, for "indefinite" read infinite.

In the August issue, Article by Isidor Ladoff, page 341, 43d line in second column, for $E = bL$ read $E = \frac{bL}{3}$.

# Correspondence

## From our London Correspondent

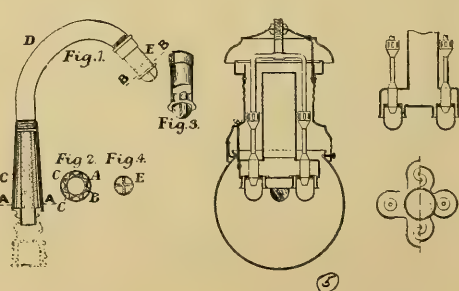
It may be interesting to note that on this side, the practically universal adoption of incandescent gas burners has had the effect of decreasing the out-put of the larger gas undertakings; especially is this the case where the authorities have taken the trouble to educate the consumer as to the enormous increase in illumination and decrease in gas consumed as compared with the old flat-flame burners. We say old, for certainly they have passed out of use almost entirely.

The area of the City of London is quite a small one, we mean the London which is under the jurisdiction of the Lord Mayor and Corporation. This is made very apparent upon the perusal of the report upon Public Lighting just issued by the City Engineer. The number of incandescent gas lamps was only 2,765, of these 2,678 were square and 87 circular lanterns. Consumption per lamp ranged from 3 up to 21.75 cubic feet per hour, but by far the larger number consumed 4.25 cubic feet. High pressure gas burners required 10 to 20 cubic feet, one burner consumed 100, and six 60 cubic feet per hour. The lamps were lighted during the day owing to fog on 33 occasions and entailed an additional cost of £219. 2s. ($1,051.68).

The main thoroughfares are lighted by electric arc lamps; there are 400 of the older type, the cost of each being $124.80 (£26). Flame arc lamps are now being installed; in Cannon Street eleven magazine flame arc lamps, five of the Oliver and six of the Gilbert make have been put up; these are suspended over the roadway by wires attached to the buildings on either side. The maintenance cost of the Oliver arcs is stated to be $84.00 (£17-10-0) per annum. Another enclosed arc known as the "Reason" has been fitted up on special short columns, the maintenance cost of these is reported to be $60.00 (£12-10-0) per annum.

In Berlin the Pharos system of lighting is being developed, the lamps are especially installed for lighting shops. One of these lamps with an inverted mantle will give, we are told, an illumination of 2,000 candles for an expenditure of 3 cents per hour. The Pharos is a self-contained acetylene lamp; they are largely used by automobilists on this side.

The illustrations show an arrangement of mixing devices particularly applicable to inverted burners supplied with intensified or high pressure gas. It is claimed that the particular devices described provides for complete mixture of air and gas, prevents ignition in the tube, avoids carbonization and foulness, securing complete combustion of the gas. Fig. 1 shows a vertical sectional elevation. Fig. 2 a horizontal sectional line A. Fig. 3 a perspective view of the burner, broken to show the interior; whilst Fig. 4 is a horizontal section of the burner on line B. The mixing device comprises two concentric tubes either cast in one or soldered together. The interior tube has a number of channels forming air ducts on flues. These present the return of the flame or the ignition of the mixed



air and gas at the base of the tube. These tubes shown at C present a series of spaces of smaller section at the top, than the base. Within the exterior tube D is screwed and curved to any suitable form, in this tube the burner E is fitted. Openings are formed in the external tube to allow for the entry of secondary air, which associates with the mixture of gas and primary air issuing by the upper orifice of the internal tube.

The trend of gas illumination is the use of clustered inverted burners. We show in Fig. 5 a lamp with bunsen burners so arranged that the ends to which the mantles are attached lie inside, and the air admission openings outside the heat-zone. Each burner has a separate and independent draught, a partition separates the burner at the mouth or lower end, from the upper portion, in which is the air intake. It is claimed that this arrangement prevents the products of combustion from unduly heating the upper portion of the burner, or vibrating the air which enters the air intake. This is brought about by means of a cylindrical chamber having in its lower face holes corresponding in number to the burners; each hole is provided with a circular depending lip or flange bent outward at its lower edge. As there is no central opening the draught of air that enters the globe on its way to the uptake or flue, is compelled to pass through the openings immediately surrounding the mantles, the result being that the tendency to blow the flames on one side is overcome and an equal incandescence of the mantle is assured.

FIG. 6.

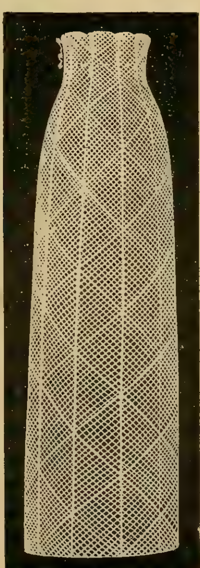
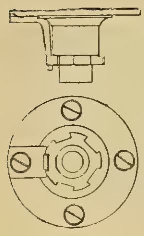
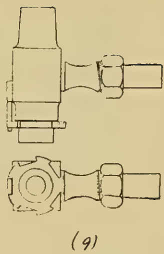


FIG. 7.

Many improvements in incandescent burners and mantles are being made in France. M. Laforce was the first to draw attention to the Esperanto incandescent burner; this burner will give a field of 10 candles, with a consumption of 0.353 cubic feet per hour. In the burner is included an improved valve with pressure governor, no gauze is used but a fine platinum sponge self-kindler has been adopted. For these burners of the inverted type a mantle of Ramie fibre, see Fig. 6, has been designed; the ends are worked into a thick block and are traversed by ribs four times their strength, in which asbestos has been interwoven. The mantle for upright burners is shown in Fig. 7. In these mantles, the weaving is from below upwards, so that there are no false folds. The fibres used are of the largest variety and are woven with very slight torsion. We are told that these mantles do not crack or split, they give a pure white light of 120 candles. Even after use they can be lifted without cracking. They have a life of over 1,000 hours and then a light of 100 candles can be maintained. Tests have been made by Dr. Bunte who certifies that they will give under a pressure of 1.4 to 1.32 inches, with a consumption of from 4.45 to 4.55 cubic feet of gas per hour, a maximum light at 30 hours and retain this quite undiminished at 150 hours. The mantles for inverted burners use 2.79 cubic feet of gas at 1.4 inches pressure.

Accidents through the falling of heavy chandeliers are not as common as they used to be, for the simple reason that it has become the vogue to use very light fixtures for gas illumination. Still a safety device for suspended fittings is worth describing. M. Ricard, another Frenchman, has devised a special union fitted with a toothed wheel in which an independent pawl engages; this is fixed either on the ceiling plate (Fig. 8) or else upon special union (Fig. 9). It is quite easy to make one of the notches of the ratchet coincide with the pawl so that inadvertent unscrewing becomes impossible.





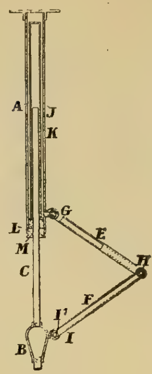
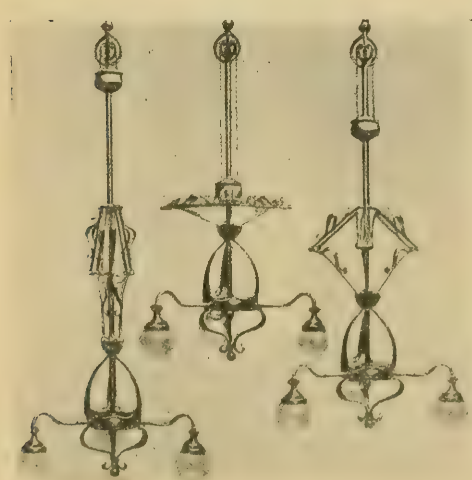



FIG. 8. FIG. 9. FIG. 10.

There have been several adjustable pendants or gas fittings introduced in recent years. We have in this magazine called attention to several novelties. These chiefly have had adopted to them the now very popular flexible metal tubes. We have before us something that is distinctly new in adjustable pendants. In Fig. 10 we give a sectional elevation. In this pendant the gas supply is in communication with a tube or annular chamber, shown in the diagram A. This is closed at the lower end, the pendant burner having a chamber B closed at its upper end by a rod or closed tube C extending upwards, being guided centrally within the inner wall of the chamber A. Both chambers are connected by a pair of jointed tubes E. F, pivoted to each other and to the chambers A, B, or to



FIGS. 11, 12, 13.

lateral branches extending from them by means of hollow plugs G. H. I. This arrangement permits of a free passage of gas at any elevation of the pendant. A reference to Fig. 10 will explain the working of the special joints and tubes. All the advantages of the sliding pendant and the counter balanced chandelier are secured without the dangerous disadvantages. The illustrations Figs. 11, 12 and 13 show the pendant respectively drawn down to its fullest length, pushed up as far as it will go, and hanging at the intermediate distance. A central counterbalance weight is used and slides, noiselessly on the other tube, as shown. In this chandelier no stuffing box water-joint, slide, or rubber tubing is required or used. It may be adapted for any number of lights and lends itself to almost any design.

There are still uses for Anti-Vibrators, notwithstanding the vast improvements that have been made in the toughening of mantles for incandescent burners. We have just received particulars of an anti-vibrator for inverted burners and illustrate same in Fig. 14. Very considerable

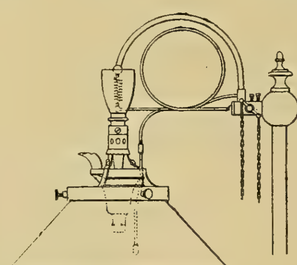


FIG. 14.

difficulty has been found in adapting the general type of anti-vibrator to the inverted burner owing to the heat striking against the supply pipe and the need of providing some kind of pilot. The invention under review, which has been made in the workshops of Messrs. Sugg & Co., of London, has several novel features; separate pipes are employed for the main supply and the pilot light, these are wound into parallel coils—see illustration—and so form a spring, they are then led to the top of the burner and pilot-light. In order to pass the gas supply pipe to the pilot-light the opal or porcelain cone of the burner is nicked or notched at the

edge, instead of being bored through the main body. The coiled pipes partially support the weight of the lamp, but it is further supported from an arm or bracket with a spring enclosed in a shield to protect it from the heat.

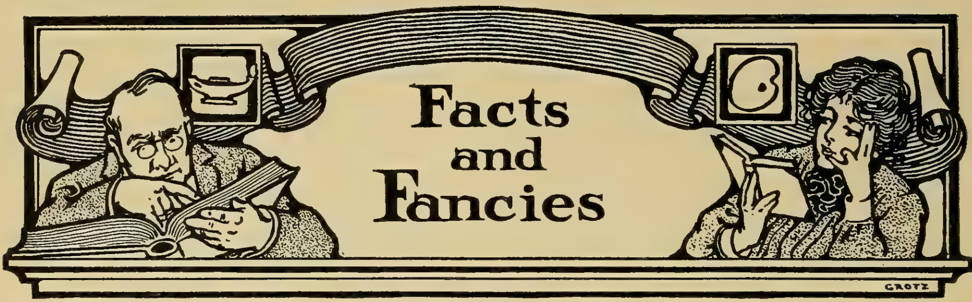
In THE ILLUMINATING ENGINEER for last March we briefly described, and illustrated a burner, the Methane in which rod filaments were used. We now give, Fig. 15, an improvement, this burner

FIG. 15.

which is called the Hella Bushlight. The filaments take the place of the mantle; they are suspended over a bunsen burner, as shown, and quickly become incandescent. The Bushlight has a number of rods on filaments fitted into a disc of hardened clay; these rods, or as they are sometimes called, needles have a thickness of 0.8 mm, and a length of from 25 to 30 mm. They consist of theorium and cerium mixed with a paste and then subjected to a baking process in a kiln or furnace of a temperature of about 2,000° centigrade. The process of manufacture which is protected by patent was described at some length in our previous notice. These Bushlights are being exhibited, at present only one size is manufactured. The filaments can, we understand, be made to give off various colored lights, violet, blue, red or yellow. This is done by means of the introduction of certain oxides. This is not all, the inventors tell us that the bushes can be made to any design, stars, flowers, etc. They may be used with petrol gas, acetylene and alcohol, in either portable or fixed lamps. Placed over a mixture of 80 per cent of air and 20 per cent of gas the inventor states that the filaments will become incandescent immediately. It is said of the Bushlight that "It produces a better light than the best mantle made. It is perfectly rigid, and practically everlasting. It produces a light of uniform intensity. Is unaffected by draught, wind or rain. Surely such enconiums must be convincing but whether the British public will prove their appreciation of this wonderful invention remains to be seen; a company is being "prospected" but meantime the incandescent mantle of commerce is selling well.

CHARLES W. HASTINGS.

London.



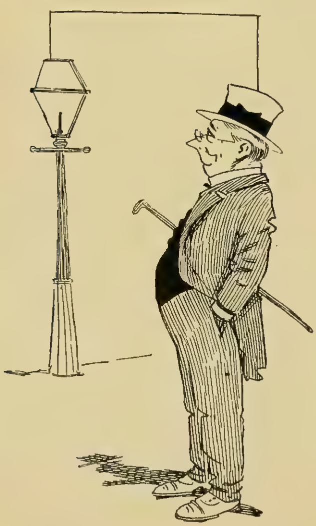

# The Totem Pole.

By Guido D. Janes.

Corrytown was a progressive city with one exception, and this exception was in the nature of a human being called Thad Warde.

When the city council decided to light the streets with gas, Thad became blue and endeavored to get up a petition to stop the improvements. But no one would sign the said petition, after which the council smiled up their sleeves, and passed on the third and final reading of the ordinance to light the city of Corrytown with gas.

But after the gas mains were all laid, and neat lamp posts were erected over the corporation, and a good quality of illumination given out each P. M., Thad became quite reconciled to the change. In fact he became so reconciled that he apologized to the council in his own mind and looked on the sunshine in life.



BECAME QUITE RECONCILED.

One night, however, a month after the new illumination had been installed, Thad left his sleeping room window open. It was in early June, and as he snored along through the night, a strong breeze sprang up and wandered through a street lamp that stood quite contiguous to the above mentioned open window. In wandering it trod upon the jet in such a manner, as to extinguish the light, leaving the raw gas to do as it pleased.

Naturally enough the raw gas strolled into the open window, and bothered Thad to such an extent that he quit snoring.

"Modern improvements will cause my death," he remarked, sitting up in bed and coughing.

"What's the matter?" asked Mrs. Warde.

"Matter? The city council is trying to asphyxiate us with their illumination outside."

"So I observe" said Mrs. Warde between a cough. "Awful".

"Most certainly. I'll raise a row on the morrow. I'll give the city council some clouds without a single sterling lining."

So early next A. M. Thad went to the city hall and said cruel things to the chairman of the Board of Public Works. Then he ordered the gas light in front of his residence to be taken away.

"Can't do that," talked the chairman, "but if you wish you may substitute a kerosene light instead. You must pay for its maintenance though."

"All right".

So Thad strolled over to a planing mill and ordered an artistic pole to be made for a lamp. This being done he substi-

tuted it for the gas one, and on top of it placed an old kerosene burner.

"I like that much better" said Thad. "No danger of becoming extinct now by gas".

"You are right" said Mrs. Warde kissing him.

But three weeks later quite a storm arose about midnight while Thad was asleep as usual, and blew the kerosene lamp pole, illumination and all against Thad's residence. In a few minutes there was a job for the fire department.

Thad awakened about that time, and made a remark that would look quite out of place here.

He then awakened Mrs. Warde, and together they strolled out of the house. They did not even stop long enough to unlock the door for the firemen when they would come.

Quite naturally Thad felt irritated on the following morning as he viewed his residence reposing in an ash heap. But realizing that he himself was the cause of it, he did not sue the city or come out in the daily paper criticising the fire department. Instead he borrowed a looking glass from a friend, and looking into it shook his fist several times. Then he had his residence rebuilt.

About that time the Civic Beauty Club, composed of the most prominent women in Corrytown, decided Corrytown was not

HE WOULD NOT LISTEN TO HER PLEADINGS.

THE TOTEM POLE.

good looking enough, especially in lamp posts. So going to the city council they prevailed upon that body to make all the said posts artistic as well as useful. As Mrs. Warde was a member of the Club, it fell her lot to influence her husband to put art into the old kerosene lamp post in front of the residence.

At first he would not listen to her pleadings, but after a while his face lightened up.

"I have a scheme" he remarked.

"What is it"?

"Import a totem pole from British Columbia. Plant it in front of our residence where the wooden pole now stands. On top of the totem pole place the kerosene light. There we will have art, common-sense, and safety. It will be safe because if it should blow down it would clear our house, and not incendiary it."

"Good idea" said Mrs. Warde with several smiles sauntering over her countenance. "Let's do it. Of course the light will be quite removed from the ground, but it will please our Civic Club. Write for one now."

So Thad wrote to British Columbia for a totem pole, and one was shipped straightway, arriving in Corrytown within two weeks. The pole was erected at once and the illumination placed on top of same.

At first the Civic Beauty Club did not know how to take it. But when Thad explained that it possessed art, the club members were satisfied. In fact they went to Thad's residence in a body and viewed the new lamp post from the street. After which they thanked Thad for his public spirit and adjourned sine die.

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## Energy Consumed for Light

In a lecture delivered by Sir James Dewar on "Flame" before the Royal Institution in London he showed the large amount of energy expended in the production of a small amount of light. The following figures show how inefficient the various lighting devices now employed are from a scientific point of view: Candle: Percentage of light, 2; non-luminous energy, 98. Oil: Percentage of light, 2; non-luminous energy, 98. Coal gas: Percentage of light, 2; non-luminous energy, 98. Incandescent lamp: Percentage of light, 3; non-luminous energy, 97. Arc lamp: Percentage of light, 10; non-luminous energy, 90. Magnesium lamp: Percentage of light, 15; non-luminous energy, 85. Incandescent lamp: Percentage of light, 99; non-luminous energy, 1. —Scientific American.

## A New Paper on Lighting Phenomena

We believe the following copy of letter received by us after a heavy thunderstorm is worthy of a place among the many masterful papers which have appeared this year in various technical publications touching the subject of lighting phenomena.

June 12th, '08.

Electric Co.,
City.

Gents!

We call your kind attention to the fact that every time as a bad weather comes —lightning striking somewhere wires— every time the pole out door our factory is stroken, the transmission appears out of order and a dangerous event may happen some day. So just now 9¼ o'clock, a flame about 5 yards big sprung from the switch—offer a detonation and big flame on the pole—sprung into the shop pretty near striking our men working near by.

There must be something wrong and we beg you to look over the whole electric plant and to test the transmission or what ever may cause this regular anxious appearances—so far natural cause will allow a proportional safety.

You will highly oblige,
Yours resp.

(From Stone & Webster Public Service Journal.)

# Commercial Engineering of Illumination

## The Rivals

Gas as an illuminant has on several occasions in the past been pronounced dead; but as in Mark Twain's case, the "accounts of its death have been much exaggerated." Its funeral oration was prepared by the inventors of the electric lamp, but the "remains" were never ready for the obsequies. The recent improvements in the electric lamp have likewise been heralded as presaging the early dissolution of gas lighting; but gas continues to light.

In time of war, however, over-assurance is an extremely dangerous attitude. More victories have been won of flanking movements than by pitched battle. There is no question that gas lighting has suffered from over-confidence, and from the advantage taken of this by the electrical interests in stealing marches into the enemy's country. There seems to be no doubt that the use of gas for lighting purposes is on the increase, but that is not the whole question; is it increasing as rapidly as the use of the electric light? That is the true measure of its progress. There are many evidences that it is not keeping up this pace. Against the higher efficiency electric lamps and more scientifically designed globes and reflectors for utilizing their light, gas presents the inverted burner and the gas arc. Well and good: the electric interests are not content with merely presenting their improved lamps and accessories; they follow up their presentation with expert knowledge and advice as to the best methods for their use in order to secure the desired results in illumination. In other words, they make use of illuminating engineering to its fullest extent in pushing forward their army of invasion. The gas people thus far have done practically nothing in this line. Now, an army may make progress without an engineering corps, but the army with such a corps will make the more rapid progress, and will by this advantage alone be able sooner or later to turn the flank of its adversary. In point of efficiency gas lighting still takes the lead, but its advantage in this regard can be readily offset by more skillfully using the electric light. The electric interests with the aid of an illuminating engineering corps can easily out-march the gas lighting interests without such assistance and this is precisely what is taking place. In a word, the electric light plus illuminating engineering can beat gas light without engineering.

How long is it going to take the gas interests to wake up to this fact? Every day that this obvious fact is neglected the more difficult it is going to be for them to head off the rapidly marching hosts of electricity. Gas may be putting its best foot forward, but electricity is putting its best feet forward,—and it is a centipede at that. There is every whit as much opportunity for illuminating engineering of gas light as electric light; on the other hand illuminating engineering can be of as great service in maintaining gas as a first class illuminant.

# Explanation of Lighting and Power Contracts

(CONTINUED.)

By A. H. Keleher.

In some cases where the cost of making a breakdown connection is excessive, the money outlay therefor is made wholly or in part by the customer. Some breakdown contracts call for a minimum monthly charge for current consumed.

TERMINATION BY SALE OR LEASE.

Many people object to signing any form of lighting or power contract for one year. To provide for such cases the following qualifying clause to the regular contract can be inserted:

"It is agreed that in the event of the sale or the transfer or assignment or expiration of the lease, this contract may be terminated by the customer on any by written notice given to the Company not less than 10 days in advance of the time when the desired termination is to occur."

REDUCTION OF BILLS.

A great many merchants fruitlessly spend a great deal of time complaining about the size of their lighting bills. A number of them blame the Central Stations for this, claiming that they should be given a wholesale rate. In a majority of cases this contention cannot be borne out, as the customer's connected capacity and current consumption are too small to entitle him to the reduced rate. In such cases, one remedy readily suggests itself: why not make use of the high efficiency tungsten lamps? The figures given here sum up the whole situation by showing the saving due to the use of these lamps in the case of Madden & Co., New York. This merchant's bill for the use of 40 lamps (carbon incandescent) in his windows, for three hours per night during 26 nights, per month, 12 months per year, or a year's use, was $209.66. These lamps were replaced with three 100 watt Tungsten lamps with Holophane concentrating reflectors in each window, whereupon the bill fell to $56.16 per year. Adding on $14.74, the cost of tungsten lamp renewals, at $2.10 each per 800 hours of burning, the total yearly cost for the new installation was $70.90, showing a saving of $138.66 per year, or about $11.00 per month. Nor in this do we have the whole story. On proving by this experiment the economy of the tungsten lamp, Mr. Madden equipped his entire store with them. Incredible though it may seem, the lighting bills for the whole store dropped from $40.00 to $12.00 per month, and the new illumination was found to be vastly superior to the former.

With regard to wholesale lighting, inspection of the formulae for figuring the amount of the bill for a month, i. e., $C=.2xy+80$, and $C=.2xy+.04z$, show that for equal illumination that a customer burning on the Wholesale "A" rate can save by replacing his carbon installation by tungsten lamps. The smaller x and z are made, which is attained by using the wire filament lamp, the smaller C, the amount of the bill, becomes. There is to consider, however, the fact that if the installation is cut down too much, there will be no advantage in using the wholesale form of contract. Nevertheless this does not disprove the statement that there is a saving due to the use of the Tungsten lamp. The matter can be made clear by an example. A large restaurant burns 240 carbon incandescents (16 c. p.) 5 hours per night, 30 days per month, the whole year round. His rated capacity is then $240 \div 20=12$ kilowatts. His monthly bill is on the "A" contract, $.2\times12\times30+80=\$152$. If the Tungsten lamps cut down the installation to 10 K. W. his bills will be $.2\times10\times30+80=\$140$. In the case of this restaurant, when the installation is exactly 8 8-9 K. W., the amount of the bill would be the same when figured on an "A" basis or on a retail lighting basis, thus:

"A" $C=2\times8\ 8/9\times30+80=\$133$.

Retail Lighting. $C=5\times30\times80\times\$.10=\$133$.

If the connected capacity dropped from 12 K. W. to 5 K. W. as would probably prove the case, the lighting bill would be, $5\times5\times30\times\$.10=\$75$. Therefore the saving due to using the Tungsten lamps, neglecting their cost, would be $\$152—\$70=\$82$, which is quite an appreciable amount

*(The End.)*

## The National Commercial Gas Association Convention

The next annual convention of this organization will be held in Chicago, December 8, 9 and 10 in the First Regiment Armory. The exhibition of gas appliances, which was omitted last year on account of the financial panic, will be held again this year in connection with the convention. The American Gas Institute is co-operating in this exhibition, being represented by three of the committee of seven which have the matter in charge.

The program of papers is as follows:—

### Program of Papers.

"Selling Gas During Depression,"
Frank A. Willard, Rochester, N. Y.

"Advertising of a Public Service Corporation,"
E. St. Elmo Lewis, Detroit, Mich.

"Industrial Fuel Gas and Special Appliances,"
S. Tully Wilson, Denver, Colo.

"Exhibition of Appliances a Necessity in Purchasing,"
Henry L. Doherty, New York City.

"Complaint and Application Departments with New Business Departments,"
A. von Dachanhausen, Butte, Mont.

"Records for a Commercial Department,"
Charles M. Cohn, Baltimore, Md.

"The Consumer,"
C. Willing Hare, Philadelphia, Pa.

"Methods of Increasing Gas Sales in a Small Town,"
Glen R. Trumbull, Lebanon, Pa.

"Demonstration Work,"
Mrs. Helen Armstrong, Chicago, Ill.

"Compiled Record of New Business Methods," George Williams, New York.

Papers will also be presented on the following subjects:

"Gas for Lighting."
"Appliance Sales Room."
"Selling of Coke."
"Qualifications for a Solicitor."
"Pushing of Gas and Electricity Under One Control."

The social side of the convention has been well looked after, and will include the following features:—

There will be tendered a public reception to military officers, architects and leading Chicago citizens and their families, by the Association at 8 o'clock on Monday evening, December 7th, at the Armory, in Exhibition Hall.

On Tuesday evening a Theatre Party.

On Wednesday afternoon a Matinee Party for the ladies.

By invitation, on Thursday afternoon the ladies will be escorted through the model store of Marshall Field, where tea will be served.

The selection of theatre performances will be so varied as to suit the several tastes of those attending.

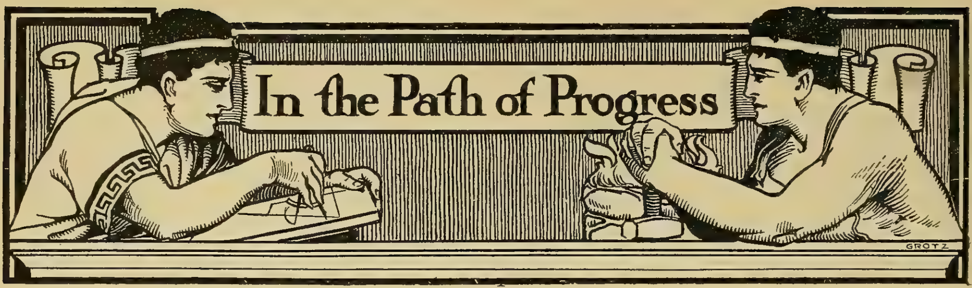
Lunches will be served to those holding "Social Side" coupon books, without extra charge.

## Announcements

Dr. Edward P. Hyde, formerly with the Bureau of Standards, Washington, has associated himself with the Engineering Department of the National Electric Lamp Association, and will organize and direct a department of physical research under the auspices of, and at the expense of the Association.

Mr. Louis B. Marks, formerly of 220 Broadway, New York, and Mr. J. E. Woodwell, recently Engineer in the United States Government Service at Washington, have opened an office in the Terminal Bldg., 41st Street & Park Ave., New York as Consulting Engineers in mechanical, electrical and illuminating engineering.

D. C. and W. B. Jackson have recently opened offices in the India Bldg., at 84 State Street, Boston, in addition to their Western office in the Commercial National Bank Bldg., Chicago.



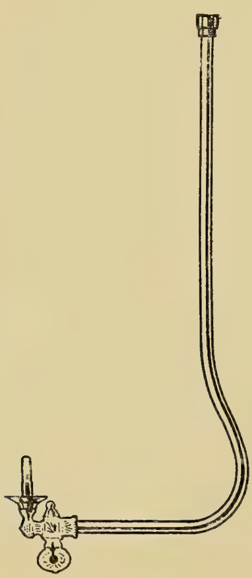

## A Safety Gas Cock

"A handsaw is a good thing, but not to shave with," says an old proverb. Illuminating gas is a good thing, but not to breathe, except a few misguided individuals who prefer to fly to ills they know not off rather than endure those that they have, no one cares to breathe an atmosphere wholly or in part of iluminating gas; and yet there have been many cases where, through accident or carelessness, such an atmosphere has been breathed with fatal results.

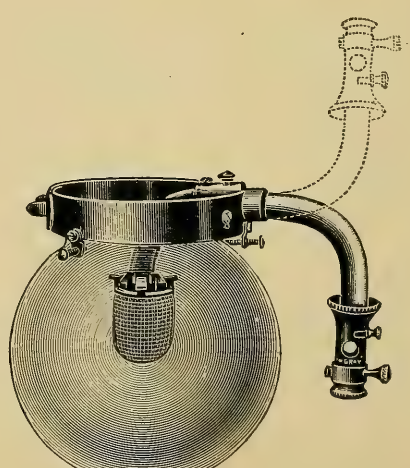
The very simple little device illustrated is intended to prevent such mishaps. It is simply a well constructed gas cock, having a spring latch which locks the key firmly in position when it is closed, so that it is impossible for the gas to be turned on by accident. There is no complication about it and nothing to get out of order; in fact, the construction is such that it is much more dependable in all respects than the ordinary gas cock. When the seriousness of results which this little device is intended to prevent is considered, its use would seem to be a precaution which there is no excuse for neglecting. The device is manufactured by Shapiro & Aronson, Brooklyn, N. Y.

## The Bray Reversible Inverted Burner

"Of making many books there is no end" said Solomon; and anyone who has followed the development of gas lighting for the past three or four years will be inclined to apply the same expression to the inverted gas burner. The making of good books, however, has never been overdone, and this likewise may be said of inverted burners. The Bray gas burner, or tip, for the open flame has been known



S. & A. SAFETY FIXTURE.



THE NEW BRAY INVERTED BURNER.

for forty years, and is considered a standard; and it goes without saying that the name, Bray, would never be attached to any gas burner that had not proven to possess positive merit. The chief feature of the burner is its extreme simplicity, as shown by the illustration, and also the fact that it can be readily attached to the ordinary upright gas fixture, or to fixtures designed especially for inverted burners. It is adjustable to any pressure between one and four inches, and is said to have an efficiency of twenty-five candles per cubic foot. It is noiseless in use and can be turned on like the flame burner without striking back.

## A New Interchangeable Letter Electric Sign

An electric sign in which the letters can be put together to form any desired wording as easily as a child arranges his alphabet blocks is the latest announcement in the field of spectacular lighting. The value of the electric sign as an advertising medium has never been questioned. The only draw back has been the expense and difficulty involved in constructing the signs; each one being a separate piece of engineering work, and when once installed being practically unchangeable. The exceedingly clever invention by which every one can be his own sign builder is due to Mr. H. J. Walser, the President and General Manager of the A. & W. Electric Sign Company of Cleveland, Ohio. The device consists of a panel or cabinet, constructed of galvanized sheet iron. This panel is covered with an enameled letter plate which is fastened by sliding over flanges in such a manner to make it waterproof. This plate is pierced with holes outlining the letter or figure; through these holes are inserted specially designed receptacles containing the electric lamps. The device is wireless, i. e., all the connections are provided for in the following manner: Within the panel there is an insulating plate, upon the face of which is mounted a perforated copper plate which makes contact with the shell of the specially designed removable socket. On the back of the insulating plate is fastened a perforated brass plate, the holes of which are threaded to receive the stem of the removable socket, which passes through the perforations of the other plate, and makes contact for the central connections of the socket and lamp. The perforations are so arranged so that any figure or letter in either twelve or sixteen inch sizes can be produced on each panel. Each letter is protected by a separate fuse. The letter plate is ornamented with a border of white and a back ground of blue; the letters being in white against the blue back ground. The letters are thus practically weatherproof and indestructable, as well as attractive in appearance, and legible by daylight as well as by night.


THE NEW A. & W. LETTER PANEL.

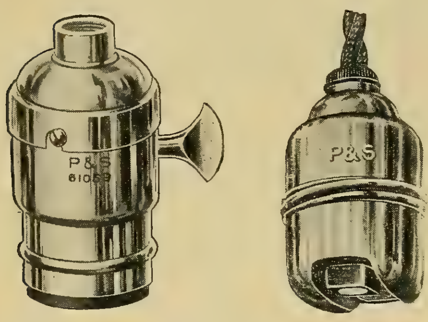
The sign should prove specially valuable for renting purposes, a branch of the sign business which is rapidly growing among central stations. The ease with which a sign can be formed up and placed in position as a demonstration should especially appeal to the central station manager. The reputation of the A. & W. Electric Sign Company is a sufficient guarantee of the practibility and substantation construction of this exceedingly ingenious device.

## The New "Wrinkle" in Sockets

The undefinable thing generally known as "good taste" is mostly a matter of attention to details. One of the small details in fixture construction which has been troublesome from the artistic stand point is the key of the ordinary electric socket, which is of a different material from the socket, and both unnecessarily conspicuous and awkward. In the socket illustrated this troublesome detail has been obviated by the substitution of a metal key, which can be given the same finish as the shell, besides being smaller and less conspicuous than the ordinary composition key. The socket is one of

the late products of Pass & Seymour, Inc., Solvay, N. Y.

A very neat pendant switch by the same manufacturers is also shown.




PASS & SEYMOUR ALL METAL SOCKET AND PENDENT SWITCH.

## The Humphrey Inverted Gas Arc

The advantages of the inverted mantle burner are too well known and generally conceded to require any comment here; likewise the gas arc as a light source of high efficiency and large total candle power has won a prominent place among commercial light sources. The adaptation of the inverted principle to the arc is therefore a combination which must be considered a genuine advancement in gas lighting, and to a certain degree an offset to the higher efficiency electric lamps which have created so much stir within the last two years.

The construction of an inverted gas arc, however, is far more than the mere placing of several inverted burners close together within a single enclosing globe. There were many difficulties arising from this combination which had to be carefully worked out. The makers of the well known Humphrey gas arc claim to have solved the problem, and it may be safely assumed that they would not jeopardize their reputation by making any unfounded claims. The inverted gas arc may therefore be accepted as another step accomplished in a progress of gas illumination.

## The Rector Gas Lamp

We have already described this new and distinct form of inverted burner, but the following communication gives additional information.

The Rector gas lamp is an upright lamp carrying inverted mantles, thus combining the best features of both the upright and inverted lamp, with a special feature of its own, in that it may be used in the ordinary chandelier or gas globe, and therefore does not require special glassware.

It may be used with one, two, or three mantles, and does not stain the chandelier fixtures, nor does it carbonize like the ordinary inverted lamp, which is due to the fact that the gas and air mixture is working with gravity instead of against it, except for the very small downward course of one inch, necessary to carry the gas mixture over and into the mantle. The usual type of inverted lamp conducts the gas mixture into a gas globe and therefore requires three or four inches of downward course, necessarily entailing carbonizing on low pressure. Tests made by the Electrical Testing Laboratories of New York on the Rector chandelier lamp, show a blue bunsen flame at the burner head on a pressure as low as one tenth of an inch.

The photometer test shows 240 candle power for the three mantle lamp on a nine foot gas consumption. It is now possible, therefore, to make the chandelier a really efficient and beautiful fixture. Any amount of candle power from 50 to 1500 may be produced on one chandelier, while the brilliant white light brings out as never before, all the beauties of colored, etched, cut or beaded glassware. The higher candle power may be produced by using a two or three mantle lamp on a four to six arm fixture.

# Proceedings of Technical Societies

## Review of the Papers Presented at the Second Annual Convention of the Illuminating Engineering Society

### The President's Address

Dr. Louis Bell, president of the Society, used as the theme for his presidential address: "Street Lighting, Considered in its Broader Aspects". Dr. Bell made an extended tour abroad during the past summer for the special purpose of studying European methods of street lighting. The results of this investigation, as expressed in his address, are not complimentary to American practice, which he finds far inferior in general to that of Europe. The inferior results obtained in this country he attributed more to the failure to properly use the different light-sources than in the selection of the lamps. The chief difficulty lies in the fact that the light is spread out too thin, and too little account is taken of the character of the street. The character of the street, and the city's resources are the two principal considerations. Where traffic is light the illumination can be likewise comparatively low in intensity; where the traffic is heavy the streets should be well lighted. In outlying districts sufficient lamps should be used to clearly mark out the street. Large units are obviously unsuitable. It is better to put in smaller units at shorter distances. Generally speaking, the principal streets of American cities are poorly lighted; the secondary streets not so badly; in outlying streets the illumination is an utter failure. In the streets of European cities there is no difficulty in reading a newspaper; the rule in London is ¼ foot candle intensity. Secondary streets are lighted about the same as the ordinary streets here, but in the outlying districts many small gas units are used in place of large ones. European street lighting is particularly marked for the diffusion of the light, and more attention must be given to this point.

The matter of uniformity is not the only requirement; a street may be lighted uniformly and still be badly lighted. Also they may be lighted with a sufficiently high minimum and still badly lighted. Dr. Bell took particular exception to the method of measuring street illumination in this country, claiming that measurements taken normally to the rays encourage badly lighted streets. He also attacked the deliberated specialization of lamp design to give .02 to .03 foot candles at a certain distance or angle. He advised that illumination measurements be taken at a horizontal plane at a height of 4 feet above the roadway, and claimed that .1 foot-candle horizontal signifies more than .1 of the alleged normal measurement. In Europe the lamps are so placed that it is a matter of indifference whether the illumination is measured as horizontal or normal; the difference between the lamps being approximately 4 or 5 times the height of the post.

Referring to the question of moon-light schedules, Dr. Bell states that the intensity required in street lighting is assumed as .02 foot-candle from the fact that this is supposed to be the equivalent of moonlight. Moonlight, however, is vastly better diffused than any artificial light, and hence the illuminating effect is better. Normal moonlight is less than .02 foot-

candle, at half-moon being .1 of that amount, and in only one week during the month does it rise to the high point. Half night lights are better than a moonlight schedule, as there is some reason for reducing illumination after midnight. Concluding with some predictions as to the future, Dr. Bell expressed the opinion that the old types of both gas and electric lamps now in general use must all go to the scrap-heap within the next three or four years. Better street lighting is demanded for the safety and convenience of the citizens.

Report of the Committee on Nomenclature and Standards: presented by Dr. A. C. Humphreys.

The work of this committee has thus far been confined to efforts looking toward the establishment of an international standard of luminous intensity (candle-power). The question has been considered in conjunction with committees appointed by the American Institute of Electrical Engineers, and the American Gas Institute, while Dr. W. S. Stratton and Dr. E. P. Hyde represented the Bureau of Standards of the U. S. Government. The work thus far accomplished may be summed up as follows:—

A recommendation that the candle-power units of the United States, England, and France be given a value representing the mean of the present values, which is 2% less than the value of the United States Standard candle-power, and that, until definite international action shall have been taken, a unit of this value be used by the U. S. Bureau of Standards.

The Committee is working through the proper channels to secure international agreement to this unit. The Hefner unit used by Germany differs so greatly from the candle-power standard as to necessitate its ratio to the candle-power being determined and agreed upon, rather than being taken into account in establishing a mean value for the candle power.

*Modern Gas Lighting Conveniences; by T. J. Litle, Jr.

The paper is chiefly devoted to a brief but clear description of present methods of lighting and extinguishing gas burners. These are included in three general divisions; electrical, mechanical, and pneumatic. The electrical systems are divided into the jump spark system, in which a high tension current from an induction coil is used to produce the ignition spark, and the make-and-break system, in which a low tension current gives a spark by breaking the circuit. In both sytems the gas may be turned off and on by electro-magnets in connection with the gas cocks. The former system is suited for large installations, while the latter is preferable for residences

Mechanical means consist of the well-known by-pass or pilot flame ignition. In large installations such as show-windows, etc., pilot flames may be maintained on a separate supply pipe, and any given number of burners be lighted or extinguished by turning the gas cocks on the two systems. The system may also be easily operated in connection with a clock, thus taking the place of the time switch in electric lighting.

In the pneumatic system a small plunger air pump connected with fine copper tubing is used to operate the pilot flame.

The new mantle burner, and flexible gas tubing are also mentioned as modern developments in gas lighting conveniences.

The Illuminating Value of Petroleum Oils; by Dr. Arthur H. Elliott.

Dr. Elliott gives in tabulated form the results of experiments with the different types of kerosene oil burners, using the various commercial illuminating oils. The most interesting practical point brought out is the fact that the flat-flame burner using an inch wick is the equal of the round flame burner, and is remarkably constant and steady in the light produced. While the data given will seldom be required by illuminating engineers, they are the result of original investigation, and give definiteness to a subject that has heretofore been little known.

Street Lighting; Fixtures and Luminants; by H. Thurston Owens.

Mr. Owens divides street lighting into five distinct groups:—1st, retail business districts; 2nd, wholesale business districts; 3rd, residence streets in residence districts; 4th, prominent thoroughfares in residence districts; 5th, outlying country roads. He firmly believes that street lighting, including the lamp posts, should be decorative, and gives American and

foreign examples to illustrate his position. His recommendation for the different classes of lighting are as follows:—

In retail business districts utilizing the trolley poles, where such exist, for lamp posts. Where only underground conduits exists any of the several forms of illumination can be used. The lamps should be hung from 15 to 20 feet above the street, and should be equipped with frosted or dense opal globes, having a maximum candle-power of not over 400.

For wholesale business districts arc lamps are most satisfactory.

In residence streets the units should not be larger than 60 c. p., placed upon posts not more than 12 feet above the side-walk, located alternately on each side of the street.

In prominent thoroughfares and residence districts, arc lamps should be placed at the street intersections on alternating corners, and not more than 300 feet apart. If the streets are lined with trees the mast arm suspended should be used. If the traffic is heavy additional lights should be furnished by intervening arc lamps or small units.

In outlying districts, it is impossible to obtain uniform illumination, and therefore does not matter greatly which type of lamp is selected, provided it is placed on alternating sides of the street.

A very interesting bit of information is brought out that as the appearance of lamp posts and lamps improves, wilful destruction decreases.

### Structural Difficulties in Installation Work; by James R. Strong.

Mr. Strong devotes his paper chiefly to the problem of so arranging the outlets for lighting installations that they will meet the requirements of future conditions, and the varying ideas of different owners or tenants. The substantial construction at present required in electric wiring renders such precautions especially necessary, since alterations are expensive and difficult.—He rightly claims that a little additional cost in the first installation may save much trouble and expense later. In residence lighting a change in the color scheme of the wall-paper and decorations may necessitate additional lighting, which should be provided for in the wiring installation. Arrangement of furniture must also be taken into account. and the different notions of the possible tenants.

"It would seem," says Mr. Strong, "that in designing the lighting for an office building the proper method of procedure is not the one frequently followed of arranging the circuits in each separate office irrespective of any consideration of adjacent rooms. Such a method is to be avoided even though the floor space has been leased before the plans have reached the hands of the illuminating engineer. The better method is to consider each floor as a whole, bearing in mind the class of tenants who would be likely to occupy an office building in a given locality."

"Office buildings are generally arranged with the main or high partitions midway between windows; a certain minimum size is selected for an office space, and the larger offices are multiples of such a minimum space. If, therefore, the outlets for general illumination are placed on the center line of windows, and if other outlets are placed around the ceiling a short distance inside the lines of partitions it would seem as if every possible requirement could be met by simple fixtures, and the outlets not needed be capped up.

This plan would probably involve a greater number of outlets in the original layout than absolutely necessary; but when it is considered that no changes would probably be required it will be appreciated that the additional first cost would be more than made up in saving in the maintenance cost of the first few years. Moreover, the installation as a whole would manifestly be a better one, owing to such freedom from changes and alterations and already pointed out, the offices would be more rentable."

### Architecture and Illumination: by Emile G. Perrot.

Mr. Perrot considers that illumination may be divided into two parts, necessary lighting and decorative lighting.

While these two divisions necessarily merge into each other, their relative importance will depend upon the general character of the architectural treatment of the building. If the building is considered as a structure intended to serve the practical uses of man the illumination will be of the former type. "If, however,

architecture is considered in its real significance as being ornamental construction, one of the fine arts, and possessing in addition to its technical value, aesthetic and phonetic values,— that is, beauty and power to tell a story,—then illumination becomes only the handmaid of architecture, as are painting and sculpture."

Mr. Perrot believes that the architect should design the fixtures for a building just as he designs the carving for a column capital or the bas-relief enrichment of a frieze, for the use of stock patterns for any feature of a building is reprehensible. On the other hand nothing is more striking in a building than a lighting fixture when in use at night time."

The Singer building in New York is referred to as a very successful combination of architecture and illumination, while the illumination at the Pan-American Exposition of 1901 is given as an example of the utmost degree of harmony between illumination and exterior architectural effects.

In conclusion, Mr. Perrot refers to the necessity for the collection of data bearing on both the theoretical and practical sides of illumination for the use of those taking up the profession.

### The Intensity of Natural Illumination Throughout the Day: by Leonard J. Lewinson.

This paper gives the results of a series of experiments carried on by the Electrical Testing Laboratories to determine the intensity of natural illumination both during the day and night. The tests were made by the best and modern instruments by experienced observers, and are therefore authoritative so far as they go, but as Mr. Lewinson very aptly remarks "To make a complete survey of the subject would involve years of effort. The author recognizes the inexhaustibleness of this field of research, as well as the limitations of the data here presented."

The following are the conclusions arrived at:

"Certain cloud formations have the effect of increasing the intensity of illumination by diffusion. Other clouds act as absorbing media, and decrease the illumination intensity. Variations in intensity due to clouds, are often of a large order, and sometimes occur suddenly.

In the absence of clouds, the rate of change of intensity, between the hours of 8 a. m. and 4 p. m. is regular.

The rate of change of intensity during the hours of dawn and twilight, is very high.

The skylight value at night, when there is no moon, is approximately .001 foot-candle.

The intensity of moonlight is about .014 foot-candle.

Daylight illumination varies in intensity from 2000 to 8000 foot-candles, between the hours of 8 a. m. and 4 p. m."

### The Integrating Sphere in Industrial Photometry: by Clayton H. Sharp and Preston S. Millar.

The paper gives brief but very clear descriptions of the construction of this valuable form of instrument, and the theoretical considerations upon which it is based. The principle upon which it is constructed was first utilized by Prof. Blondel, and more fully developed by Ulbricht. It was in practical use for arc lamp photometry in Germany a year or more before being utilized in this country. The various discrepancies and sources of error in the instrument are clearly described. The advantages which it possesses are thus set forth:—

"Simplicity of Construction. The parts are few and easily built. There is an entire freedom from the complication which has been the blight of other integrating photometers.

No adjustment of parts necessary. A sphere, when correctly designed, needs no adjustment. The only thing likely to change is the character of the interior surface, the coating of which may have to be renewed from time to time. The only attention required is occasional cleaning to prevent dust from destroying the surface for photometric purposes.

Absence of flicker due to rotation of lamp. This fact means higher precision and higher speed in photometric settings.

Greater facility in arc lamp tests. Since the total flux of light is utilized in the integration, all effects due to the wandering of the arc are minimized.

Elimination of breakage due to rotation of lamp. A very important item, as those who have conducted tests upon metallic filament lamps can attest.

May be used in a light room where necessary. This fact renders the use of the sphere practicable where other photometers could not be employed because suitable dark rooms are not to be had.

Higher accuracy than other integrating photometers. A number of causes contribute to this greater accuracy. It is superior to photometers of the Matthews type in that it gives a true integration of the light rather than a summation. All values of the luminous intensity of the lamp are taken account of, while in the Matthews type some important values may be omitted altogether and have no influence on the result. An example of this advantage has been seen in tests of magnetite arc lamps."

## The Ives Colorimeter in Illuminating Engineering: by Dr. Herbert E. Ives.

Dr. Ives' paper is a report of experiments carried out with this ingenious instrument for the purpose of comparing the color values of the different light-sources. The following brief but comprehensive description of the instrument is given:—

"It consists essentially of an oblong box, at one end of which are placed four slits, one clear, the three others furnished, respectively, with a red, a green and a blue color screen. By means of levers the openings of the three colored slits may be altered to read by scales from zero to one hundred. Within the instrument is a wheel of lenses which when rotated rapidly by a small motor causes the three colors to pass across the field of vision of an eyepiece, thus mixing them by persistence of vision. The optical arrangements are such that one observes a divided field, one-half consisting of the mixture of three colors, the other the color to be matched, as viewed through the clear slit. For ordinary use a white surface reflecting the light of the sky serves as standard white, the fabric observed being illuminated by the same light. To make a measurement, the three levers are opened until white is matched, and the scales are adjusted to read 100 for each color (this method compensates for slight differences in color vision of different eyes); then any color matched by moving the three levers can be read off in terms of the red, green and blue used to match white."

In order to obtain a standard white the color values of average daylight were obtained from fifteen sets of observations made during an interval of three weeks. The values of the red, green, and blue thus obtained were each taken as 100 in the comparisons made with artificial light.

The following were the results obtained:—

### Table I—Colorimeter Readings on Various Sources.

| *Source* | *Red* | *Green* | *Blue* |
|---|---|---|---|
| Average daylight | 100 | 100 | 100 |
| Blue sky, mean of five sets | 100 | 106 | 120 |
| Overcast sky, mean of four sets | 100 | 92 | 85 |
| Sunlight, 2 p. m., August 19th | 100 | 95 | 68 |
| Sunlight, afternoon observations, 2 to 5 p. m. | 100 | 91 | 56 |
| Nichols' average daylight (acetylene flame and A. O. Co. blue glasses 5 and 1) | 100 | 69 | 42 |
| Carbon arc, direct current | 100 | 64 | 39 |
| Mercury vacuum arc (Cooper Hewitt) | 100 | 130 | 190 |
| Moore carbon dioxide tube | 100 | 120 | 520 |
| Welsbach mantle, 1¼ per cent. cerium | 100 | 81 | 28 |
| Welsbach mantle, 2¾ per cent. cerium (mantle preferred by Welsbach Co. for residential illumination) | 100 | 69 | 14.5 |
| Welsbach mantle, 3¼ per cent. cerium | 100 | 63 | 12.3 |
| Tungsten lamp, 1.57 watts per mean spherical c. p. | | | |
| Tungsten lamp, 1.25 watts per mean horizontal c. p. | 100 | 55 | 12.1 |
| Nernst glower, bare, 118 volts, .4 ampere | 100 | 51.5 | 11.3 |
| Acetylene flame | 100 | 50 | 10.4 |
| Tantalum lamp, 2.5 watts per mean spherical c. p. | | | |
| Tantalum lamp, 2.0 watts per mean horizontal c. p. | 100 | 49 | 8.3 |
| Graphitized filament, 3.1 watts per mean spherical c. p. | | | |
| Graphitized filament, 2.5 watts per mean horizontal c. p. | 100 | 48 | 8.3 |
| Glow lamp, 3.9 watts per mean spherical c. p. | | | |
| Glow lamp, 3.1 watts per mean horizontal c. p. | 100 | 45 | 7.4 |
| Flaming arc | 100 | 36.5 | 9 |
| Helium tube | 100 | 37.0 | 9 |
| Gas flame, open fish-tail burner | 100 | 40 | 5.8 |
| Moore nitrogen tube | 100 | 28 | 6.6 |
| Hefner | 100 | 35 | 3.8 |

Experiments were also made on the appearance of colored fabrics under different light-sources, from which the writer concludes that the best light for matching colors is that of the Welsbach. The writer reaches the following conclusion:—

"The result of the work thus far done with the colorimeter as applied to illumi-

nating engineering may be summarized here: By means of the colorimeter the colors of all types of sources may be described in terms of a given standard such as daylight. The figures expressing the color of a light are a fair indication of the change in the color of objects illuminated by it."

### Calculating and Comparing Lights from Various Sources; by Carl Hering.

The purport of this paper is best set forth in the writer's own words:—

"The present paper is an attempt to clarify the apparent mistiness surrounding many of the calculations of light, by giving the formulas in such a form that they can be directly used for numerical calculations, and to explain in plain terms some of the less usual but often very useful and perhaps not generally understood laws; it is also an attempt to show what the real physical meaning is of the various quantities involved so that they may be used more intelligently, as their names sometimes mislead. It will then be shown by practical numerical examples how these various laws and formulas may be used for calculating and comparing lights from entirely different kinds of sources."

It is impossible to abstract this paper since it deals with the various mathematical problems involved in photometry, and especially with the formulae expressing all the different possible relations of the several photometric quantities. Several matters are treated in a distinctly novel way, and the paper as a whole is the most complete and satisfactory exposition of the measurement of light and illumination that has yet been given.

### The Calculation of Illumination by the Flux of Light Method; by J. R. Cravath and V. R. Lansingh.

"It is the object of this paper," the authors state, "to give certain methods employed by the authors for a number of months past in calculating the illumination of large interiors and to show the practical application of the excellent suggestions made by Dr. Clayton H. Sharp in his presidential address before the first annual convention of the Illuminating Engineering Society at Boston, July 30, 1907. The authors expressed the opinion at that time that the simple methods suggested by Dr. Sharp would be of considerable practical value, and immediately upon the close of the convention worked out methods of applying them in every-day engineering practice."

Their methods consist in determining the mean spherical candle-power or flux of light through the effective angles, reducing this flux to lumens and from lumens to foot-candles on the given area to be illuminated. They find that

"In a small room with very dark walls and the lamps placed high, the zone of useful light as measured by the angle from the vertical would be small, sometimes not over 50 or 60 degrees. On the other hand, in a very large room with few obstructions and with light-colored walls, the light which emanates from the source at a considerable angle from the vertical ultimately falls on the working plane and becomes useful. The area illuminated by each lamp is very large in such a case and each point in the working plane receives illumination from many lamps."

The following table is given "as the result of a careful consideration of all the evidence obtainable, and is believed to be approximately correct."

### Table Showing Number of Watts per Square Foot of Floor Area Required to Produce an Average of 1 Foot-candle of Illumination. (Watts per Lumen.)

*Incandescent Lamps.*

| | |
|---|---|
| Tungsten lamps rated at 1.25 watts per horizontal candle power; clear prismatic reflectors, either bowl or concentrating; large room; light ceiling; dark walls; lamps pendant; height from 8 to 15 feet .......... | 0.25 |
| Same with very light walls......... | 0.20 |
| Tungsten lamps rated at 1.25 watts per horizontal candle power; prismatic bowl reflectors enameled; large room; light ceiling; dark walls; lamps pendant, height from 8 to 15 feet .............................. | 0.29 |
| Same with very light walls.......... | 0.23 |
| Gem lamps rated at 2.5 watts per horizontal candle power; clear prismatic reflectors either concentrating or bowl; large room; light ceiling; dark walls; lamps pendant; height from 8 to 15 feet ................. | 0.55 |
| Same with very light walls.......... | 0.45 |
| Carbon filament lamps rated at 3.1 watts per horizontal candle power; clear prismatic reflectors either bowl or concentrating; light ceiling; dark walls; large room; lamps pendant; height from 8 to 15 feet...... | 0.65 |
| Same with very light walls.......... | 0.55 |
| Bare carbon filament lamps rated at 3.1 watts per horizontal candle power; no reflectors; large room; very light ceiling and walls; height from 10 to 14 feet........... | 0.75 to 1.5 |

Same; small room; medium walls .......................... 1.25 to 2.0

Carbon filament lamps rated at 3.1 watts per horizontal candle power; opal dome or opal cone reflectors; light ceiling; dark walls; large room; lamps pendant; height from 8 to 15 feet ...................... 0.70

Same with light walls ............... 0.60

*Arc Lamps.*

5-ampere, enclosed, direct-current arc on 110-volt circuit; clear inner, opal outer globe; no reflector; large room; light ceiling; medium walls; height from 9 to 14 feet............ .50

### Street Lighting with Gas in Europe; by E. N. Wrightington.

Mr. Washington's paper is very brief, and the following extracts are particularly pertinent:—

"Gas is used for street lighting in the Continental European cities in many forms. Both inverted and upright mantles are used under ordinary and high-pressure. The low-pressure upright lamps comprise the principal lighting of the side streets. The high-pressure upright lamp is just coming into use for the lighting of the principal thoroughfares. The inverted lamp is, however, taking the place of the upright type. The low-pressure inverted lamps are used for ordinary illumination, and the high-pressure inverted lamps on the main streets.

The most striking feature of the street lighting on the other side is unquestionably the use of high-pressure inverted gas lamps. These lamps are found in very large units, running as high as 3600 mean lower hemispherical candle-power. The posts are placed near together, and the streets are almost as bright as if lighted by daylight. One might expect to find the light rather glaring, especially as the lamps are hung rather low; on the contrary, however the light is beautifully diffused, the effect being very soft and pleasing."

### Design of the Illumination of the New York City Carnegie Libraries; by L. B. Marks.

The paper is devoted chiefly to a description of the lighting installation in the St. Gabriel's Park branch, which is representative of seven other Carnegie Library buildings now under construction in New York City. Floor plans showing the arrangement of outlets, sketches of the several types of fixtures used, and the results of illuminometer measurements are given. The following is a summary of the features of the installation:—

"(1) Freedom from glare. No unshaded lamps. Intrinsic brightness of lighting sources, 1/10 of a candle-power per square inch.

(2) General illumination combined with localized illumination.

(3) General illumination one foot-candle on horizontal working plane.

(4) Illumination (horizontal) on reading tables, average working conditions, 5 foot-candles.

(5) Illumination (vertical) on bookshelves 1½ to 4 foot-candles.

Illumination (horizontal) on bookshelves 4 to 8 foot-candles.

(6) Combination of general and localized lighting designed to secure maximum illumination on the working spaces at minimum cost of operation for the required results.

Ceiling pendants for general illumination designed for efficient use of tungsten lamps.

(7) Flexibility. Design of switching arrangements for economical use of light. Lights near windows placed on same circuits so far as possible.

(8) Lamps for general illumination hung high but low enough to avoid sharp contrasts on the ceiling.

(9) Lamps for general illumination enclosed in 16 inch crystal glass globes roughed on the outside.

(10) Lamps for table lighting provided with prismatic reflectors designed to throw the maximum light sideways instead of downwards. Frosted lamps used.

(11) Lamps for lighting low bookshelves screened from view by opaque parabolic reflectors. Lamps for lighting wall bookcases, backed by opaque trough reflectors.

(12) Lamps for lighting free standing bookcases and reading tables screened from view by green plated glass domes.

(13) Lamps for lighting exhibition racks screened by reflectors with green celluloid covers.

(14) Wall bracket and column bracket lamps provided with deep enamelled glass diffusing shades of sufficient depth to hide the lamp. Frosted tip lamps.

(15) Cheerful appearance of room."

### Engineering Problems in Illumination; by Alfred A. Wohlauer.

Mr. Wohlauer first sets forth his conceptions of the relation of the duties of the illuminating engineer to those of the architect and client; refers to some of the early investigations in the line of light distribution, and then proceeds to the mathematical consideration of the problems of obtaining uniformity, which, he says, "practical experience has demonstrated as the chief requirement for good illumina-

tion." The subject is treated in a strictly theoretical manner.

THE INTRINSIC BRIGHTNESS OF LIGHTING SOURCES; by J. E. Woodwell.

Mr. Woodwell deals with the effect of intrinsic brightness, or glare, upon the organs of vision. He thus summarizes the more important hygienic effects of light-sources of high "intrinsic brilliancy within the field of vision may then be summarized as follows:

1. Contraction of the pupil is caused, thereby reducing the amount of light entering the eye and the consequent visibility.

2. The sensibility of the visual organs is temporarily impaired by residual images and retinal fatigue.

3. The effects of (1) and (2) are also produced by the occasional view of bright sources or by subjecting the eye to sudden fluctuations of light.

49. Intrinsic brightness rather than the distance of the source from the eye is the principal cause for pupillary contraction.

5. The harmful effects are greatest in proportion to the decrease in the working illumination and are considerably reduced under an illumination exceeding 2 foot-candles.

6. The different luminous sources may be classed with reference to producing pupillary contraction and after-images in the same order as their respective intensities."

SOME EXPERIMENTS ON REFLECTIONS FROM CEILING, WALLS AND FLOOR; by V. R. Lansingh and T. W. Rolph.

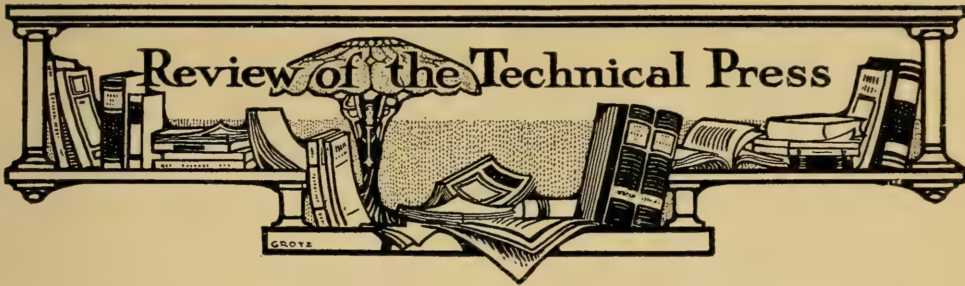
The experiments consist in illuminometer measurements in a room in which the covering of the walls and ceiling was varied from dark to light, and the light-sources from one to three, with and without reflectors. With one bare lamp the average illumination varied from .19 to .68 foot-candles; with one lamp and reflector .36 to .90 foot-candles; with three bare lamps from .48 to 1.96 foot-candles; with three lamps with reflectors from .91 to 2.27. The lamps were 40 watt, 115 volt Tungsten, and the reflectors were of the prismatic type.

THE RELATION BETWEEN CANDLE-POWER AND VOLTAGE ON DIFFERENT TYPES OF INCANDESCENT LAMPS; by F. E. Cady.

Mr. Cady's paper is the report of a careful and exhaustive series of experiments to determine the exact mathematical relation between voltage and candle-power of all the different forms of incandescent electric lamps now in use.

## Discussion of the Convention Papers Before the New Section

The regular meeting of the New York Section was devoted to an abstract and discussion of the convention papers. The most important part of this program was the discussion of Dr. Ives' paper on the "Ives Colorimeter." In the paper on this subject presented at the convention the Moore carbon dioxide, or "white light" tube, was given as containing a larger amount of blue rays than even the Mercury arc. This fact elicited a strong reply from Mr. Moore, who quoted the color values obtained by German authorities to sustain his contention that the carbon dioxide tube is the only complete substitute for "average daylight". Previous to the meeting of the New York Section, Dr. H. E. Ives, the inventor of the instrument, personally carried out a series of measurements of the carbon dioxide tube in comparison with actual daylight at the laboratory of the Moore Electrical Co. The results obtained gave 67 for the blue, as against 520 reported in the convention paper. This figure was obtained in comparison with the sky; and, as pointed out by Dr. Ives, this was somewhat bluer than the value generally given to average daylight, so that the results obtained were substantially concordant with those given by the German authorities. Dr. Ives explained the discrepancy by the fact that the measurements reported in the convention paper were necessarily made in comparison with an arc lamp, which was fluctuating widely on account of varying voltage. The fact that measurements made under proper conditions correct this apparent error is exceedingly gratifying, since it removes the very serious doubts which the convention paper cast upon the accuracy and practicability of the Ives Colorimeter. The value of such an instrument to illuminating engineering is very great, and the work of Dr. Ives in this field so successful in the past, that it was a keen disappointment to those who looked to the Ives Colorimeter to solve many of the vexing difficulties of color values when the discrepancy of the convention paper was brought out. The test reported by Dr. Ives is therefore a most welcome assurance of the real value of the instrument.




# American Items

AMERICAN AND EUROPEAN STREET LIGHTING; by Dr. Louis Bell, *Electrical World*, October 3.

A short and pithy article in which the writer expresses the same views which he set forth in his presidential address at the Illuminating Engineering Society Convention. The closing paragraph is especially significant.

The writer has sometimes sinned in the past by joining the procession of shuffling apologists willing to put up with so-called "standard" practice in street lighting; in the future he proposes to stand uncompromisingly for adequate illumination, such as is now in this country hardly more than accidental. It is not creditable to American cities that they have not undertaken reform in lighting ere this. They come out strongly for lower prices, but are weak on general improvement in results. What is needed, just now, is work intensive as well as extensive—improving the lighting of the principal streets, as well as stringing occasional lamps in half-built suburban roads. We have, in this country, the enterprise, the money and the engineering skill to make American cities the cleanest, best paved and best lighted in the world, and the work of improvement ought to be started without further delay."

COMPARISON OF THREE NOTABLE STREET LIGHTING SYSTEMS; *Electrical World*, Oct. 3.

Describes and illustrates the spectacular lighting of Nicollet Ave., Minneapolis; Canal St., Grand Rapids; and Summit St., Toledo. In Minneapolis 100 watt Tungsten lamps are used, five being placed on each ornamental post; in Grand Rapids arches are placed over the streets lighted with 75 watt Tungsten lamps; in Toledo magnetite arc lamps on ornamental posts are used.

THE ILLUMINATING ENGINEER; by C. E. Roesch, Architect and Engineer, September.

Lays stress on the necessity for considering the artistic as well as the purely scientific side of illuminating engineering.

THE "LIGHTING NUMBER", October 7th, of the *Municipal Journal and Engineer*, has the following articles:—

Columbus Municipal Lighting Plant, by G. H. Gamper.

Street Lighting in Chicago.

Electric Street Lighting, by Wm. L. Puffer.

Cost of Gas and Naphtha Lighting, by Alton D. Adams.

SIMPLIFYING SOME OF THE CALCULATIONS OF LIGHT; by Carl Hering, *Electrical World*, September 26th.

A discussion of the general subject of photometric terms and formulae for the special purpose of clearing up the numerous misunderstandings and errors that have prevailed in this subject. It contains substantially the same matter as Mr. Hering's valuable paper presented to the Illuminating Engineering Society Convention.

THE RELATIVE ILLUMINATING EFFICIENCIES OF THE 8-FOOT E. H. LAVA TIP, THE SUGG "D" ARGAND, AND THE CARPENTER BURNER, EACH CONSUMING GAS AT THE RATE OF 5 CU. FT. PER HOUR ON COAL GAS OF FROM 8 TO 18 C. P. AND WATER GAS OF FROM 15 TO 25 C. P.; *Progressive Age*, September 15th.

Special Street Lighting in Various Cities; *Western Electrician,* September 19th.

Electric Signs in New York City; by Wm. Fife Turnbull, *Western Electrician,* Sept. 26.

Harbor Lights, by "R"; *American Gas Light Journal,* September 14th.

Modern Light Shades, by "R"; *American Gas Light Journal,* October 12th.

Scientific Lighting; by Norman Macbeth, *Dry Goods Economist,* September 26th.

### Editorials

*Electrical World.*

The Illuminating Engineering Society;

Light as a Protection;

Simplifying some of the Calculations of Light;

Street Lighting;

Modern Illuminants and Ultra-violet Rays.

*Electrical Review.*

White Lights for Ships and Light-houses;

A New Departure in Illuminating Engineering.

*Electrical Age.*

The Relation of Rates to Efficiency of Light-sources;

Artificial Lighting of Public Schools.

## Foreign Items

Compiled by J. S. Dow.

Photometry and Illumination.

The Photometric Standard of Light at the National Physical Laboratory, by R. T. Glazebrook, (a communication to the British Association meeting at Dublin).

Deals with a suggested alteration in the present method of measuring the water-vapour present in the photometer-room. In future this is to be measured with the "Assmann" ventilated hygrometer, which is found to give results differing by 20 per cent from those of the ordinary un-ventilated type. A consequence of this discovery is that the relations previously accepted as correct between the units of light of different countries, now need revision, and it is stated that the real ratios between the Hefner and the Bougie decimale respectively and the British candle are almost exactly 0.9 and 1.0; this result will necessitate the suggested conditions for an international standard of light being revised.

The discovery of the difference in the readings of the ventilated and unventilated hygrometers partially explains the discrepancy that has always been found to occur between the relations between the standards, as obtained by direct comparison, and the results obtained by the interchange of standardized incandescent lamps.

Beleuchtungsberechnungen fuer Quecksilberdampflampen, by K. Norden (*E. T. Z.* Sept. 10).

The author points out that the tube mercury vapour lamps deviate very far from theoretical point sources. Assuming certain practical dimensions for a lamp, he calculates the illumination at points in a plane parallel to the axis of the lamp, and also discusses the errors that are likely to arise in its photometry; for instance when the distance of the lamp from the photometer was altered from 0.6 to 2.85 metres the apparent candle-power varied by 34%.

Die Schadigung des Auges durch die Einwirkung des ultravioletten Lichtes, (Discussion of the paper by Drs. Schanz and Stockhausen, *E. T. Z.* Aug. 27, abstracted *London Illuminating Engineer,* Oct.)

Many conflicting views are expressed regarding the effect of ultra-violet light on the eye. Many of the speakers disagree with the suggestions of Dr. Schanz and Dr. Stockhausen. For instance, it was declared that ultra-violet rays were not invariably injurious and might even be beneficial to the eye, and the case of a lady was cited who suffered from cataract but recovered her sight by the aid of the rays. In general it seemed to be felt that further evidence from the physiologists was needed, though, as daylight seemed to be richer than artificial light in ultra-violet rays, most of the speakers doubted whether the fatiguing effect of the latter could be ascribed to this cause.

In a subsequent letter to this journal Prof. Blondel, (E. T. Z., Sept. 24,), speaks of his own experience. He thinks that they may be more susceptible to the effect of short-wave energy by artificial light owing to the lower order of illumination and hence the different physiological conditions. He, himself, when recovering from inflammation of the eyes, found that he could work by the light of a 3.5 watts per candle lamp without fatigue, but that the light from one running at 2.5 watts per candle proved very trying.

DIE KONSTRUKTION VON REFLEKTOREN FUER VORGESCHRIEBENE BODENBELEUCHTUNGEN, E. W. Weinbeer, (*Z. f. B.* Sept. 10).

The author discusses a graphical method of working out the shape of reflectors designed to yield a uniform downward horizontal illumination.

A NEW PHOTOMETER, by A. Blondel, (*Elek. Anz.* Sept. 10).

The author describes a new form of photometer due to Prof. Blondel and specially designed for portable use, for street-lighting, etc. The field of view is created by a small Lummer-Brodhun prism, and the source of light is a small glowlamp filament of linear shape fed by an accumulator.

EIN NEUER FLIMMERPOLARISATIONSPHOTOMETER, by S. Maisel (*J. f. G.* Sept. 19, short note.)

A brief reference to a form of flicker-photometer devised in Russia. The special point of the instrument appears to be that the change from light to dark in the flicker-photometer takes place according to a sinusoidal law, and it is claimed that this is less trying to the eyes.

ELECTRIC LIGHTING.

NEUES UEBER DIE QUARZLAMPE, by O. Bussmann, (*Elek. Anz.* Sept. 10).

The article describes, rather more elaborately than in the original paper by the same author, that appeared in the Elektrotechnische Zeitschrift some time ago, the Kuech quartz-glass mercury vapour lamp. The author describes the main features and scientific principles underlying the lamp, and gives a series of curves illustrating the connection between P. D. and current, etc.

EINFLUSS VON SPANNUNGSUEBERSCHREITUNGEN AUF DIE LEBENSDAUER VON METALLFADENLAMPEN, (*E. T. Z.* Sept. 3), by H. Remané.

The author gives some interesting data as to the effect of over-running metallic filament lamps. The effect on osram lamps running at 1.1 watts per H. K. seems to be very marked. Remane states that the useful life of a 100 volt lamp run on P. D.'s of 100, 105, and 110 volts respectively would be 1800, 900, and 370 hours, so that a rise of 10% in P. D. reduces the life to about one-fifth of its normal value. The author gives some interesting curves illustrating these and other results.

A PROPOS DES LAMPES A FILAMENT ELECTRIQUE, Henry (*l'Electricien*, Sept. 5).

UEBER ELEKTRISCHE STRASSENBELEUCHTUNGDEREN SYSTEME UND IHRE RATIONELLITAET, (*Elek. Anz. Sept.* 12 continued), by J. Schmidt.

THE EFFECT OF METALLIC FILAMENT AND ARC LAMPS ON THE EYES, (*Elec. Engineering*, Sept. 3).

A resume of the paper by Drs. Schanz and Stockhausen and the discussion referred to above.

THE MANUFACTURE OF METALLIC FILAMENT LAMPS, (*Elec. Engineering*, Sept. 3).

An abstract of several recent patents bearing on the manufacture of metallic filaments.

LAMPADO AD ARCO BLONDEL, (*l'Elettricita*, Sept. 3).

DIE NEUEREN BOGENLAMPEN, (*Z. f. B.* Aug. 30, Sept. 10, Sept. 20).

A comprehensive series of articles dealing with recent arc lamp developments. The present section deals only with lamps with carbon electrodes.

GAS, OIL, AND ACETYLENE LIGHTING.

PRESSURE-GAS INVERTED LIGHTING IN BERLIN, by H. Drehschmidt (*J. f. G.* Aug. 22; *J. G. L.* Sept. 1; *G. W.* Sept. 12).

A description of the application of high-pressure gas to the illumination of the streets of Berlin. The paper was read at the annual meeting of the German Institution of Gas Engineers, and is now reproduced in the journals cited. Though somewhat lengthy, it contains some valuable information as to experience of the details of public lighting at high pressure and is accompanied by full particulars of the polar-curves of distribution of light of the sources employed and the actual distribution of illumination over the pavement and roadway.

PUBLIC LIGHTING IN LONDON AND ELSEWHERE, by N. H. Humphreys, (*J. G. L.* Sept. 1).

This article consists mainly of a critical discussion of the recent report on the City lighting in London by A. A. Voysey, but contains a number of general remarks on street lighting in addition. One point insisted upon by the author is that it is not legitimate always to express results, on the basis of cost per illumination obtained. For instance, if a certain street is already adequately illuminated and, without increasing the expense, we succeed in getting double the light, we are not justified in assuming that the new method of lighting is twice as cheap to the ratepayers as the former one, while, even supposing that the gain in illumination is valuable, it is questionable whether results should be expressed on the above basis.

PROFESSOR J. T. MORRIS ON HIGH POWER GAS AND ELECTRIC ARC-LAMPS, by W. H. Y. Webber, (*G. W.* Sept. 12).

A very interesting critical discussion of the two recent articles by Professor Morris in the London ILLUMINATING ENGINEER. The author appreciates the value of two such articles on gas and electric lights, involving tests carried out by the same author in the same journal.

Among other suggestions, however, the author criticises the assumption that lights intended for street-lighting ought to cast all their light in the lower hemisphere and so serve the useful purpose of illuminating the road and pavement. The author suggests that many people regard a long row of lights seen from a distance as highly decorative, and, indeed, judge whether a street is well-illuminated or not more from the general appearance of such lights to the eye than the actual illumination on the pavement.

Mr. Webber also explains how it has become customary to make use of the horizontal beam only when making photometric tests of a gaslamp. This was originally intended to compare, not different lamps but merely the quality of different kinds of gas. Hence it may prove misleading when applied to compare the performances of lamps yielding widely different types of polar curves of distribution of light.

THE RELATIVE MERITS OF PRESSURE-GAS AND PRESSURE-AIR, (*G. W.* Sept. 1).

A brief resume of the arguments that have been advanced pro. and con. the use of compressed-air with gas instead of high-pressure gas itself, in the recent discussion on this subject in the Journal fuer Gas, etc.

MORRIS AND WEBBER ON HIGH POWER LAMPS, (*G. W.* Sept. 19, Editorial).

PUBLIC LIGHTING BY PRESSURE-GAS (*J. f. G.* Sept. 12, pp. 842 to 844).

THE CHIPPERFIELD HIGH PRESSURE LAMP, (*G. W.* Sept. 12).

VARIOUS PATENTS RELATING TO INCANDESCENT MANTLES, THE DESIGN OF BURNERS FOR USE WITH LIQUID ILLUMINATING MATERIALS, ETC., (*Z. f. B.* Aug. 30, Sept. 10 and 20).

Contractions used:—

E. T. Z.—Elektrotechnische Zeitschrift.

Elek. Anz.—Elektrotechnischer Anzeiger.

G. W.—Gas World

J. G. L.—Journal of Gaslighting.

J. f. G.—Journal fuer Gasbeleuchtung und Wasserversorgung.

Z. f. B.—Zeitschrift fuer Beleuchtungswesen.

# Miscellaneous News

SAN DIEGO, CAL.—It is understood that certain property owners along D street from Atlantic to Twelfth, the section which it is proposed to improve by the establishment of a new lighting system, will protest against the expenditure of funds necessary to install the ornamental iron posts and cluster incandescents.

ST. JOSEPH, MO.—Rivalry of the strongest sort has developed among the Felix street merchants, in decorating that thoroughfare in honor of the visiting soldiery. The limit was reached when tenants between Seventh and Eighth streets authorized the expenditure of $325 for hanging strings of incandescent lights along the block. Tenants in the block bounded by Sixth and Seventh streets have installed the same scheme.

Unlike the lighting of Felix street, Third to Sixth, where the bulbs have been tinted with the national colors, and stretched along the curb lines, depending from the ornamental light fixtures, the lights between Sixth and Eighth streets are white, and extend diagonally back and forth across the street. At the intersections of the lines, larger bulbs, with ornamental shades, have been placed. All of the lights serve to illuminate finely the bunting pennants in patriotic colors which flutter in profusion above the street.

ST. LOUIS, MO.—Pine street is the first to respond to the Civic League movement for better lighting of the downtown streets and for a uniform system of illuminating the section bounded by Fourth and Twelfth streets, Washington avenue and Market street.

New four-light electroliers which have been permanently installed on Pine from Fourth to Tenth streets are getting their introduction in connection with the festival illumination of the downtown streets and are attracting as much attention as the more elaborate temporary lighting.

There are 10 electroliers to each block and they brilliantly illuminate the thoroughfare.

The Street Lighting Committee of the Civic League will call a meeting shortly of property owners and merchants of the entire downtown district at the Mercantile Club, and an effort will be made to induce them to follow the example of Pine street and install the electroliers on all the streets.

HARTFORD, CT.—Bids have been submitted to the board of contract and supply, on the new contract for lighting the city, beginning June 1, 1909. The only bidders were the Hartford Electric Light company and the Hartford City Gas Light company.

The Hartford Electric Light company submitted three proposals. The first offered to continue the present arc lamps, in use under the expiring contract, at a cost of $56 per lamp, per year, for a five-year contract, or $60 per lamp for a one-year contract; the present series lights to be continued at the present cost of $18 per lamp per year.

The second proposition offers to install the lamps now on exhibition through Pearl street, at a price of $35 per lamp, per year. These lamps are run on a low voltage, as are the lights used in private houses. Outside of the district named, it is proposed to install the series Tungsten lamps now in use in West Hartford, at a cost of $15 each per year, provided one lamp is placed on each of the wire poles.

The third proposition offers to place in lieu of the present series arc light system in the district outside the present underground wire system, the Titanium carbide lamp now exhibited in Albany avenue, which gives about double the light of the existing arc lamp at a cost of $70 per lamp per year, under a five year contract.

The bid of the Hartford City Gas Light company offers to install 60 candle-power incandescent gas lights, with ornamental iron posts, care, maintenance, etc., 250 lights or more for one year, at a cost of $26.80 per lamp; 250 lights or more for a period of five years, at a cost of $22.80 per lamp.

The company also offers to install 100 candle-power Tungsten lights with poles, etc., at a cost of $20.80 per lamp under a one-year contract, or $17.80 per lamp under a five-year contract. Lamps of the Magnetite type are to be installed at a cost of $67.80 under a one-year contract, or $64.80 under a five-year contract.

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## *Contents of This Issue.*






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# Light and Labor

Whether we accept the teaching that, by divine fiat, man was compelled to provide his daily bread by the sweat of his brow, or that he has emerged and ascended from a primitive, brutish condition, the fact remains that labor has been his lot from time immemorial. We must also concede that, in a broad sense, his mental, moral and spiritual welfare has been determined by the character of his labor.

This proposition carries with it the corollary that mere labor itself is not uplifting—in fact, may be degrading: labor ennobles when its ends are noble. "The man with the hoe" is brutish because of a continual struggle with brute force. As science has gradually subjugated brute force, and made it a servant instead of a master, man has risen to a higher plane of moral and mental strength; and with this emancipation from physical and moral servitude his labor has become more precious.

Never before in the history of the world has the labor of man been so valuable as today in America; and nothing is more reassuring or comforting than the knowledge that the value of human labor is bound to continually increase; for the more valuable human labor becomes the greater will be the care and ingenuity devoted to conserving it. From the oar benches of the Roman galley to the modern American workshop is a long, long stretch in human progress.

As a mere matter of industrial economy, there is no item of such importance as the efficiency of workmen and workwomen. The "cost of raw materials," "interest and depreciation," "office expense," or any item that you will, is wholly overshadowed by the cost of labor; and there is no single utility that has a greater influence upon the actual efficiency of the laborer than the light by which he works. At least 99 per cent. of the results of labor are accomplished under the direction of the sense of vision. Imperfect or defective vision makes labor difficult, and the results imperfect. Of all things let the workman have a good light.

As human labor has become less a matter of mere physical strength, and more a matter of intelligence, the mental attitude of the worker has come to be of greater importance. The discontented worker will never equal in efficiency the contented worker; and the worker who is compelled to use poor tools, the most important of which is light, is bound to be discontented.

Light is cheering; darkness oppressive. The cheerful worker produces the most and best results and makes the fewest mistakes.

Let there be more and better light.

E. L. Elliott.

LAMP POST USED TO COMMEMORATE THE 225TH ANNIVERSARY OF THE FOUNDING OF PHILADELPHIA BY WM. PENN.

# Lamp Posts as Historical Memorials

The possibilities of the lamp post as a means of embellishment for streets and public squares are rapidly becoming impressed upon the public mind and worked out into accomplished facts. The matter of furnishing sufficient illumination in public thoroughfares is one of the recognized necessities of municipal manage-

ment, comparable with, and to a considerable extent akin to, the use of modern pavements. Street lighting, however, differs in one very important respect from street paving. While the latter is wholly utilitarian, the former is not only utilitarian but may be made more highly artistic or more aggressively ugly than is possible with any other public utility. In its general effect upon the appearance of a city, street lighting also has a far wider field than any other public improvement. The public buildings of a city are necessarily few, and its parks are, in the nature of things, seldom seen by either the transient visitor or the busy citizen. Street lighting, on the other hand, is everywhere present.

There has been within the past year such a remarkable interest shown throughout the country, particularly in the West, in artistic street lighting as to make it appear almost as if the various cities were in an actual contest to see which could produce the finest installations. While each particular case has been a credit to its designers and a just source of pride to the citizens, we must undoubtedly give Philadelphia credit for having made the most dignified and impressive use of decorative lighting thus far recorded. As compared with many cities of the old world, the oldest of our own cities are as yet mere infants; but all measurements are comparative, and a number of our cities rightly cherish the memory of events connected with their early history, and none more so than Philadelphia. This city recently dedicated a week's time to the commemoration of the first quarter millennium of its existence, and many and various were the festivities provided. In the nature of things, the usual festivities of this kind are of a transient character; the longest parade soon passes; the patriotic speech must come to a close; the band must cease to play, and the home-coming citizen and the stranger within her gates must return to their accustomed duties. It is "all a fleeting show," leaving nothing but littered streets and bedraggled bunting as an evidence of its passing.

It was a wise and admirable thought, therefore, on the part of those who arranged the celebration to seek some means of adding to the impressiveness and joy of the occasion that could remain as a permanent memorial of the historic events commemorated, and a particularly happy thought that hit upon the erection of suitably designed and executed lamp posts around the municipal center of the city in which is located its city hall. As this edifice occupies four entire blocks, and is one of the most imposing structures of its kind in this country, the opportunity for the display of such embellishments was ideal.

In order that this plan might express as much symbolism as possible, the committee having it in charge decided that the number of posts should be twenty-eight, corresponding to the number of original districts, boroughs and townships which consolidated in 1854 to make up the present city. The posts in themselves are simple and dignified in design, as befits their purpose, each supporting a shower of electric lamps in frosted globes. The material is bronze, and the execution is an example of the most finished and skillful workmanship, for which due credit must be given to the makers, the Smyser-Royer Company of that city.

The largest and most elaborate posts were placed singly at the entrances. The bases of the posts are utilized for the commemoration emblems and inscriptions, as may be seen in the illustration (Fig. 1). On one side is the new seal of Philadelphia, recently adopted, and effective for the first time this fall. On another side is a tablet stating which district, borough or township each post commemorated, and giving its boundaries. Another tablet sets forth the fact that the post is set up in commemoration of the 225th anniversary of the founding of the city by William Penn. And, finally, on another side, the original seal of the individual subdivision which the post represents.

The illustration also shows the incrustations of electric lamps with which the corner pillars of the building were covered during the celebration week, and which greatly enchanced the brilliancy of the general effect.

The lighting up of these lamps for the first time constituted the opening ceremony of "Founders' Week," and was a most impressive and beautiful spectacle. The following description is extracted from an account of the affair given in the Philadelphia *Ledger*:

Twenty-eight public school girls, in white, a white which was accentuated by the city colors of blue and yellow sashes about their slender waists, each girl a resident of one of the old time districts, christened rather than dedicated the standards.

Fully 10,000 persons surged about the City Hall, filled the streets and halted traffic. In Penn square women caught in a jam suffered, but suffered bravely. Despite the pressure the thousands remained almost silent. There was a shuffle of feet. That was all.

Not a light twinkled from the massive pile of granite. Every window—there are hundreds of them on the north, east, south and west—was dark. Like alert sentinels guarding a dungeon deep the twenty-eight standards stood out, their bronze giving forth a dull gleam from the lighter background of the City Hall wall.

Silence here. Silence made more profound by the noises from far away.

Then from that section of humanity jostling each other in North Broad street there came an anticipatory sigh. The people heard the muffled beat of drums, the faint, sharp notes of cornets. They knew then that they need not draw further on their stock of patience. From the second floor of the Municipal Building came the tramp of feet. The crowd did not cheer. It merely strained forward a bit and beat against the rope which encircled the plaza. Into view swung the Third Regiment Band, led by Edward Brinton, the musicians playing "Philadelphia." They could be heard. That was about all. In the darkness they looked like phantoms parading in solemn array about the inclosed space.

Back of this phantom band came little ghosts in rows of three, each engaging little ghost bearing a silken American flag, the middle figure larger than her companions. There were twenty-eight rows. These ghosts were the twenty-eight girls who soon were to dedicate the standards. The figures at their sides were their escorts of honor. All are pupils of the public schools.

Following close in the rear of these girls was a stockily built lad, bearing a lance at rest. It was a gay lance. Twined about it were the city colors. It was long and supple. The boy was James Hazlett, Jr., son of the president of the Select Council. The lance, or perhaps it was more like a magic wand, was the symbol by which the lights were to be flashed in turn in each of the twenty-eight standards.

Back of the lad came Mayor Reyburn, accompanied by Martin Brumbaugh, superintendent of schools; Director Clay and many guests. Well in the foreground was John Dennis Mahoney, professor at the North East Manual Training School, in charge of the ceremony. Buglers and a fife and drum corps brought up the rear.

The march around the hall was made in silence. The procession, after forming on the north plaza, turned to the west, and marched without music until the great post on the east side of the South Broad street entrance to City Hall was reached. There the procession halted and the bugles rang out a "Salute to the Colors."

Mayor Reyburn faced the post, the officials assembled back of him, the fanfare ceased.

Edna M. Clathy stepped forward. Young Hazlett held the magic wand against the glass globes. The girl pressed a button at the bottom of the wand. At the other end a little electric light twinkled.

"I christen thee in memory of the Frankford township!" rang out the stentorian tones of Professor Mahoney as the light glowed. And as though the twenty-eight symbolic lights pendant from the post had caught the spirit of fire from the microscopic dot of light held close against them the globes flashed forth their light.

Simultaneously the band played a patriotic anthem, the crowd cheered, the officials uncovered and the first post had been ceremoniously illuminated.

Between the short marches from standard to standard, the "Salute to the Colors" was sounded on cornet, fife and drum. At each post there was a brief halt while the glowing globe was held against the cold round dead lights. Then Professor Mahoney spoke the words which constituted the signal for William McLaughlin, chief of the Electrical Bureau, to press the button which communicated with the switchboard and sent the electrical current coursing along the wires bearing its gift of light to the dark standards.

Appreciative gasps arose from the throng as young and old drank in the beautiful significance of it all. Around the broad plaza marched the procession until finally there was left only one unlighted post. That was on the west side of the South Broad street entrance, across from the Frankford post lighted first.

"I christen thee in memory of Germantown township," said Professor Mahoney.

Louisa M. Schmitz pressed the button in the magic wand held out to her by Master Hazlett, the bulb lighted and an instant later lights flashed in the standard.

But that was not what caused the deep-drawn sigh from the crowd. With the lighting of the last standard the entire City Hall was illuminated. The building stood out in

columns of fire. Every projection was outlined in a sparkle of light. Lights in rows, lights in serried ranks gleamed from bottom to tower top.

At the four entrances the message, "Philadelphia Maneto. Welcome," sprang out in letters of fire to greet the stranger within our gates, while from the paintings of William Penn leaped rays of flashing light.

Near the roof were electric American flags, which rippled and floated in the breeze. Way up on the tower William Penn became visible, dressed in a white outing suit put on for the occasion.

It was no longer the black smoke besmudged Penn familiar to residents of the city. Eight searchlights trained upon him from as many angles transformed him into an altogether different person.

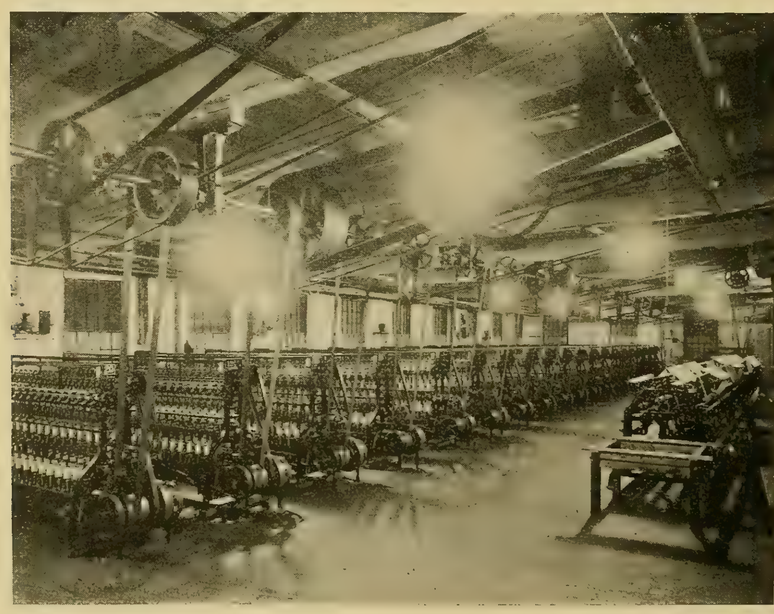
Philadelphia is not the first city to publicly celebrate the installation of artistic street lighting. St. Paul had a jollification on putting its system into operation, and doubtless other cities have likewise rejoiced; and well they may, for not only does it offer a particularly propitious opportunity for arousing interest in public matters, but is capable of making a lasting impression. Those who witnessed the turning on of the lights at the Pan-American Exposition will never forget the spectacle, and will need no argument to convince them of the possibilities in this direction.

In conclusion, we can do no better than to say to other cities who may still be in "outer darkness"—*"Go thou and do likewise."*

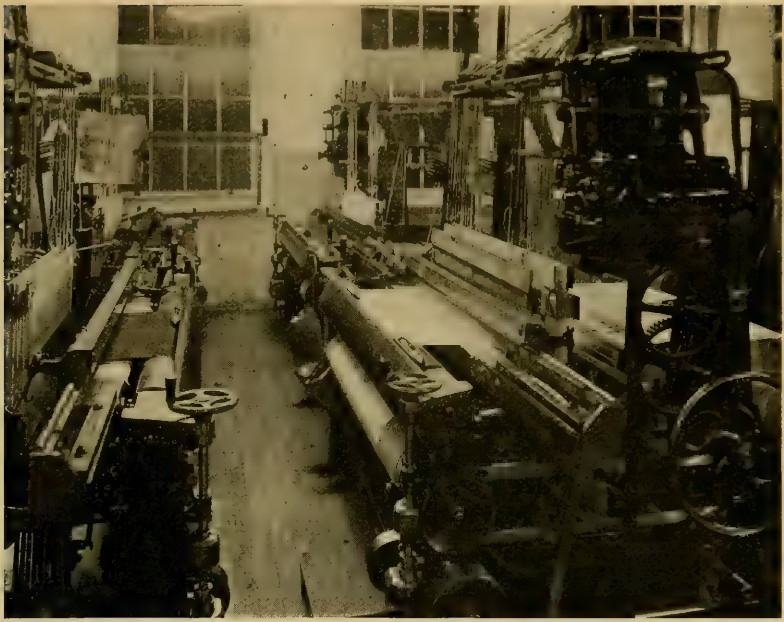
# The Mercury Vapor Lamp in the Textile Industries

By A. S. Hubbard.

If the ordinary observer were asked to give his impression of the textile industries, probably the first thing that would occur to him would be an almost endless variety of shades and colors of material, and the wonderful skill required to blend and combine them into the finished fabric; and most assuredly if he were asked to give his impression of the mercury vapor lamp, the peculiar peacock blue color of its light, by which the windows in buildings where it is used may be distinguished at night as far as the eye can reach, would first come to his mind. Even if he



SILK SPINNING OR SILK THROWING PLANT



DETAIL OF LOOM ILLUMINATION, STEHLI & CO., LANCASTER, PA.

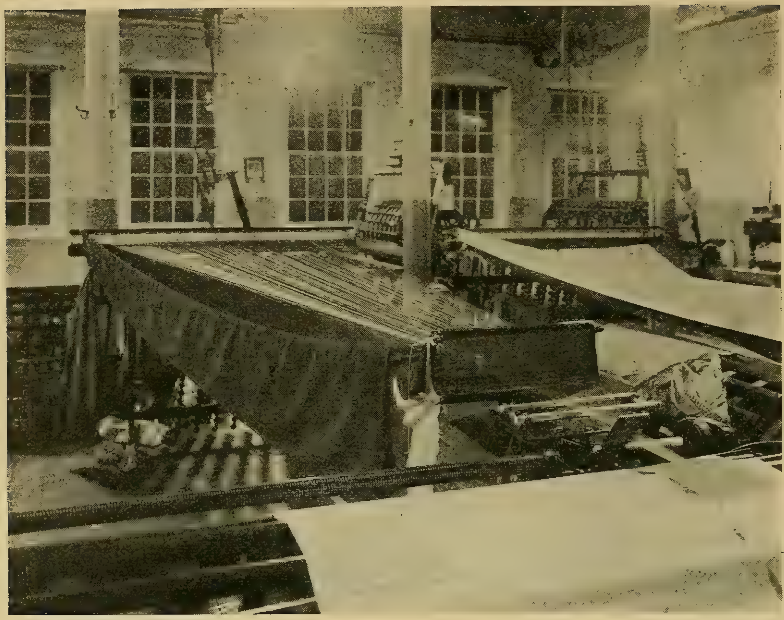
were fairly conversant with the appearance of different colors under different kinds of lights, and you were to ask him what would be the most suitable place for the use of mercury vapor lamps, a textile factory would be the last to suggest itself.

But such is the possible error of first or "off-hand" opinions. The mercury vapor lamp, in fact, turns out to be particularly well suited to most of the needs of illumination in textile mills. So peculiarly suited is it that one operator, chosen for her unusual degree of intelligence, skill and conservative judgment, pronounced it "better than daylight."

Aside from the coarser preliminary processes, and the handling of the materials in the dye house, all the operations in the production of textiles require sharp vision. The threads and fibers which constitute the materials are in themselves either minute objects, or made up of minute objects, and the machinery by which these materials are formed into the finished product is likewise delicate and often minutely complicated. The individual fibers of which the silk yarn is composed are not more than one eight-thousandth of an inch in diameter, and after being twisted together ready for the loom are frequently not more than two thousandths of an inch in diameter; yet each one of these threads forms a separate and distinct part in the production of the finished fabric, and must be individually looked after by the operator. Except in the processes of engraving, it is doubtful if there is a single industry in which such keen vision is required. While quantities of smaller magnitudes than those mentioned are frequently measured in mechanical operations, such measurements do not depend upon vision, but are read off upon scales sufficiently magnified to be easily discernible.

The most interesting feature in the use of the mercury vapor lamp in the production of textiles is the fact that the peculiar color of its light which would, on first thought, seem to entirely disqualify it for the purpose, is the very quality which gives it so conspicuous advantages over the more familiar light-sources.

Those who have observed the effect of the mercury vapor lamp with any degree of care must surely have recognized the peculiar sharpness which it gives to the outlines of illuminated objects. This is plainly shown in its effects upon ordinary black print. A sheet of common type printing stands out with all the distinctness and sharpness of steel plate engrav-



WARPING DEPARTMENT, STEHLI & CO., LANCASTER, PA.

ing; one almost unconsciously runs a finger over the surface to feel for the relief or embossed effect which is a characteristic of plate printing. This effect of sharpness is such an aid to vision as to almost make it seem as if the objects were magnified.

Understanding this peculiarity of the light, its advantages as a source of illuminaton in the textile industries will at once be apparent. The minute fibers and tiny threads which the operator must handle, and which must be kept constantly under view, stand out with the same vividness as the printed letters referred to.

Such are the facts. Now for the scientific explanation. To be sure, it is not at all necessary that we know the why and the wherefore in order to make full use of the advantages stated, but it is always a matter of satisfaction and interest to know the reason of a thing, and the knowing why is furthermore often of assistance in making further improvements, and frequently leads to valuable discoveries. A full explanation in this case necessitates a brief description of the process of vision.

The eye has often and very aptly been likened to a photographic camera. It consists essentially of a converging lens fitted with a "stop," or diaphragm (the iris), a sensitive surface at the back (the retina), and a means of focusing the lens so as to produce a distinct image upon this sensitive surface. Now, in focusing light with a lens it happens, by reason of the action of the lens upon the direction of the light which produces the focusing, that there is a different focus for every different color; in other words, if the lens be so adjusted as to focus red light, it would be out of focus for blue light; this is scientifically called "chromatic aberration." By the use of different kinds of glass of various shapes known to the optician this defect can be largely corrected; but the lens of the eye possesses no such complete means of correction. Consequently, when an object is seen by daylight, which is a composition of all the colors, the eye makes an average focus, which would probably be with reference to the yellow, which is the most active color; this means that the blue and the red rays will be more or less out of focus, and out of focus means that the outlines of objects appear indistinct.

The light from the mercury vapor lamp is approximately monochromatic, i. e., has a decided preponderance of one color—

ILLUMINATION OF RIBBON LOOM, SPIERS SILK CO., PASSAIC, N. J.

blue—and contains no red at all. The eye, therefore, focuses for this particular color and secures a perfectly sharp image; the other colors, being either faint or absent, do not blur the outlines, hence the peculiar distinctness of the visual impression.

Of course, such a light violently distorts the whole scale of color values; but when you stop to think about it, color is mostly a mere matter of decoration, so to speak, and of little practical account. Many people are more or less color blind, and, curiously enough, generally do not even know the fact. Furthermore, consider for a moment how fully objects can be represented by shades of black and white alone, as the illustrations before you will show. Furthermore, the question of color is wholly relative, depending entirely upon the kind of light in which the object is seen. We are accustomed to see objects by daylight, and hence judge colors by reference to light of sunlight composition, i. e., a light containing all the different colors in the proportions found in average daylight; but if we were to work continually in a light of different color composition we would get accustomed to the relative changes in color values, and perhaps distinguish shades or differences quite as readily as by so-called "white light." It is really astonishing how quickly we get over our first sense of shock at beholding persons with blue lips and cheeks and green countenances. It is, after all, wholly a matter of custom; and if blood were actually blue, and gave

its color to lips and cheeks, mademoiselle would seek the blueing bag with quite as much self-satisfaction as she now turns to the rouge pot.

However, the question of color does not enter at all into the actual working conditions of the majority of textile mill operations, but forms a distinct and separate department of the manufacturing process. The original color scheme is the work of the designer, and the proper arrangement of the colored yarns is the work of another specialist. For these processes, of course, a "white" or daylight quality of illumination is absolutely necessary, but in all the other operations, which are purely mechanical, the question of color is a matter of indifference. What the operator wants is to distinctly see the threads and the parts of the machine.

That the theories above set forth are sound is substantiated by the fact that a large number of mercury vapor lamps have been in use in some of the largest silk mills in the country for several years—long enough to give them a thorough tryout—and certainly no stronger endorsement can be conceived than the expression quoted at the beginning of this article, that "the light is better than daylight." While this at first sounds like a purely rhetorical exaggeration, it is in reality a sober fact. In the first place, daylight is exceedingly variable in intensity and color, and in these two respects is surpassed by any constant artificial light; and, secondly, a light of simple color composition avoids the blurring effect of chromatic aberration, which is always present with daylight. Improving on nature sounds somewhat quixotic, if not blasphemous; but on this point we may quote Professor Helmholz, one of the greatest scientists that the world ever produced, who, after a careful examination of the eye as an optical instrument, concluded with the statement that if an optician were to send him an instrument containing as many imperfections as the human eye, he would return it as unsatisfactory. If we can improve upon nature in the case of optical instruments, why not in the matter of light production?

The peculiar color composition of the mercury vapor lamp also renders certain imperfections and faults, such as grease spots, particularly noticeable. As in the case of all other manufactured products, fabrics undergo a very careful inspection before being finally packed for market. In one case, that of a plush mill, it was found by actual practice that one hundred yards of goods could be inspected under the light of a mercury vapor lamp with greater satisfaction, and in the same time that it took to inspect forty yards with ordinary daylight. This is not only an interesting point in connection with this particular form of light but an instructive example of the actual commercial value of securing that form of illumination best adapted to each particular purpose.

The peculiar distinctness of outline produced by the light from a mercury vapor lamp is equally advantageous in other manufacturing processes, but, as Kipling would say, "that is another story."

FITCHBURG COTTON YARN CO. PLANT, FITCHBURG, MASS.

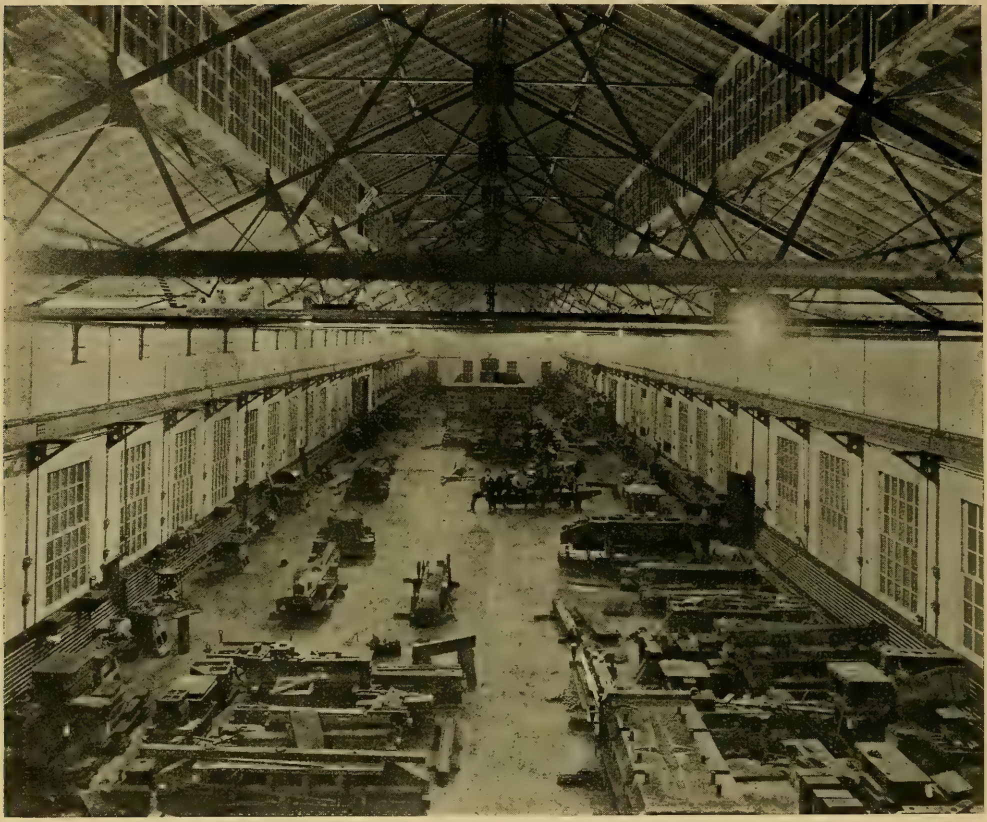
# Indirect Illumination in a Cotton Mill

The above illustration will give some idea of the conditions which the illuminating engineer must meet in dealing with textile factories. The photograph was taken in a large cotton yarn factory in Massachusetts. As in most departments of the textile industries, one operator has to attend a number of machines, and work a considerable range of space, and yet the objects that require attention are approximately distributed over this space and necessitate careful watching and sharp vision. It is plainly, therefore, a case of general illumination of a fairly high degree of intensity. Localized lighting is out of the question.

In the installation shown, inverted arc lamps equipped with white enamel metal reflectors underneath, are used, the ceiling itself being painted white and serving to diffuse the light over the space below. When it comes to producing absolutely uniform illumination on the floor, or on any plane above it, and keeping the intrinsic brilliancy of the light-sources at a point sufficiently low to avoid glare, some method of indirect illumination is practically the only solution of the problem. Where it is feasible to use the ceiling itself as the diffuser the inverted arc offers probably the most efficient method of producing indirect illumination.

Where color values are of importance practically white light can be obtained by properly selecting the enclosing globe, which must be of the right quality of opalescent glass. So true is the color obtainable by this means that it has been successfully used in the color printing department of a large publishing company, as noted in one of our previous issues.

The method of indirect illumination shown not only meets the theoretical notions of illuminating engineers but has proven highly satisfactory to the owners of the factory, and should recommend itself for all similar installations.



MACHINE SHOP LIGHTED WITH FIFTEEN INCLOSED ARC LAMPS.

# The Flaming Arc Lamp in Machine Shops

The lighting of a large machine shop constructed on modern principles is a good illustration of the wide difference in conditions and requirements between the various classes of illuminating engineering problems. Between the proper illumination of an office or a residence and the lighting of a machine shop of the character shown in the illustration, there is as wide a difference as between an ornamental foot bridge in a park and a railway span across a navigable river.

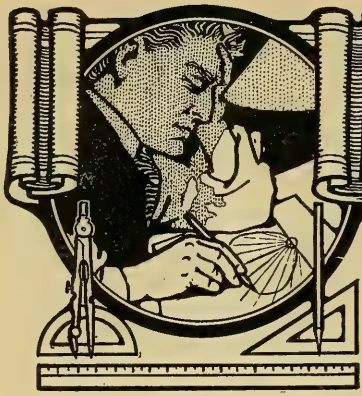
In all modern buildings designed for heavy machine construction traveling cranes are provided, which sweep the entire length and breadth of the room. A general illumination must therefore be produced by light-sources placed above the level of the traveling cranes, which generally means that they must be among the roof trusses. Furthermore, the illumination must be of a fairly high degree of intensity, evenly distributed, and free from distinct shadows. Glare must, of course, be reduced as far as possible. The case is therefore clearly one in which small units are out of the question. The familiar enclosed arc lamp has been generally installed to meet such conditions. The modern flaming arc lamp, however, by reason of its far higher efficiency—approximately in the ratio of 6 to 1—its larger total volume of light, which may, if desired, reach the same proportion, and as commonly equipped with opalescent globes, a very much lower intrinsic brilliancy, gives it unquestionable advantages for such purposes.

The illustrations show two views of the same shop illuminated with the two dif-

SAME SHOP ILLUMINATED WITH FOUR FLAMING ARC LAMPS.

ferent installations. The room is 300 x 70 feet, with 25-foot ceilings. The original installation consisted of fifteen enclosed arcs, which were replaced by four flaming arcs. One end of the room, however, which was used for storage (the end shown in the foreground) was purposely left comparatively in the shade in the new installation. The photograph fairly shows the difference in intensity of illumination throughout the main portion of the room. The flaming arc fits such cases as this as completely as the incandescent lamp fits the lighting of homes and offices.

There is probably no other branch of industry which has undergone such complete revolution as the construction and operation of machine shops. It was not long ago that the machine shop, especially the one in which heavy work was done, was a semi-dungeon, in which workmen groped their way about, performing their work by the feeble light of smoking, rank smelling torches or candles. It was Sir Joseph Whitworth, if we remember rightly, whose name today is a synonym for mechanical accuracy, who related how, in his boyhood days, the test for accuracy in fitting the piston of a steam engine to its cylinder was to drop a shilling piece in and rattle it around. If the coin did not fall through between the piston and the cylinder the job was considered a "fit." Those were the days of the torch and candle. Today we are building factories consisting of a steel framework, filled in with glass, which admits the utmost quantity of natural light during the day, and are nearly equaling this illumination with our magnificent electric lights by night, and instead of the shilling piece as a measure of accuracy we are using the micrometer reading down to the ten-thousandth part of an inch. Such is the progress that has been made within the memory of living men.



# Practical Problems in Illuminating Engineering

## The Illumination of an Auction Room

By Norman Macbeth.

An example of what can be done in securing efficient illumination at a comparatively low cost as to installation, and also the more important one which we have with us always—maintenance—by the use of that modern gas unit, the inverted burner, is given in a recently completed installation for Samuel T. Freeman & Co., Chestnut street, Philadelphia.

The art gallery department on the second floor is a room 118 feet by 41 feet 6 inches, and the question was to provide an adequate and modern lighting system suited to the requirements. The floor is used only for sales amounting to from \$5,000 to \$50,000 each. The articles displayed comprise fine art furniture, rugs and tapestries, pictures and books, bric-a-brac, rare china and cut glass, which are forced upon the market and must be turned into cash to settle estates or furnish the wherewithal to tide through a

FIG. I.

depression, enabling many to begin again more modestly who have perhaps met with misfortunes or reverses. When it is considered that the values placed upon the goods displayed rest largely with the purchaser, it would be poor economy to have insufficient illumination or illumination of a quality which would not contribute to the best appearance possible.

The system installed on this floor enables the sales directors to secure special effects which cannot be as well obtained under daylight, since artificial light is under absolute control. A picture, a beautiful rug, or a fine tapestry, under daylight may appear very different than under artificial light, especially if that light is one having good color qualities, i. e., not showing a marked deficiency in green, red or blue. Many an art piece which has seen years of usefulness and appears dull and commonplace under daylight, is rendered attractive by artificial light, thereby adding very considerably to its selling value.

line of vision of observers in the gallery. Clear prismatic reflectors were used, together with chimneys having the bottoms sandblasted. This sandblasting, as shown in Fig. 2, adds considerably to the appearance of the unit, and has the contrary effect to sandblasting on incandescent electric lamps—that is, it reduces the end-on candlepower. This is shown on the flux-polar curve, Fig. 3, the dotted line giving the end-on candlepower to 15 deg. on each side of the vertical for the same reflector and mantle with a clear chimney. It is interesting to note that the distribution secured with the frosted chimney closely approaches the theoretical uniform illumination curve for a light-source at a height of 10 feet. This is the curve shown as a straight line intersecting the left half of the polar distribution curve in Fig. 3.

This floor is rarely used as one room, the large screens to the left and in the rear, and the large curtain in the center, as shown on the photograph, Fig. 1, are

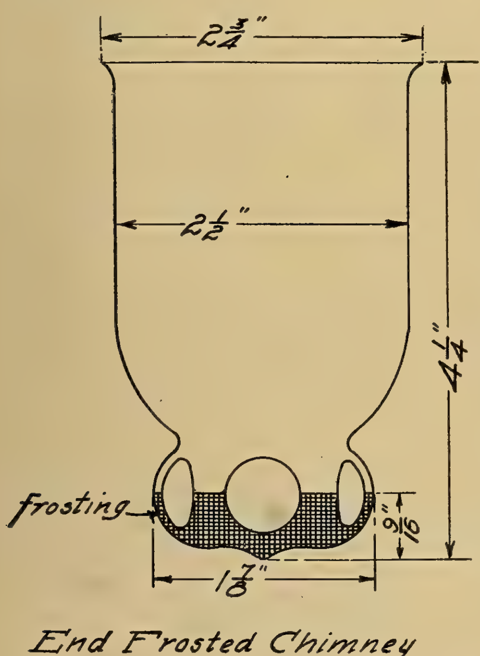



FIG. 2.

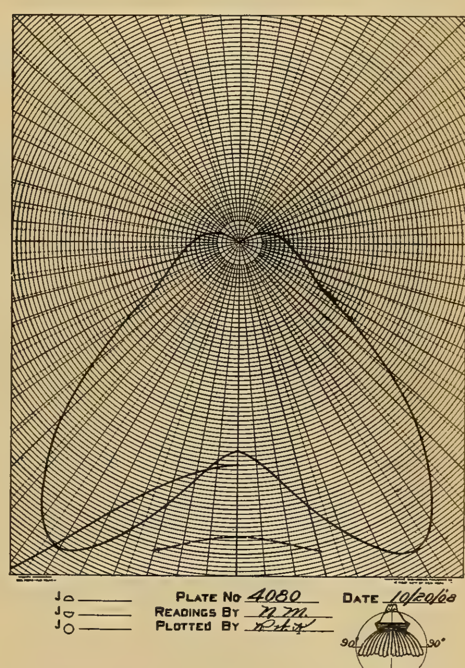



FIG. 3.

The three lines of three light fixtures, five down the center of the room and six on each side, suspended from the ceiling at a height of 12 feet and a distance of 9 feet from the side walls, are entirely out of the

used to divide the exhibit into several sections—drawing rooms, dining rooms, libraries and bedrooms. Draperies and tapestries are displayed on the screens.

In the photograph, Fig. 1, which was

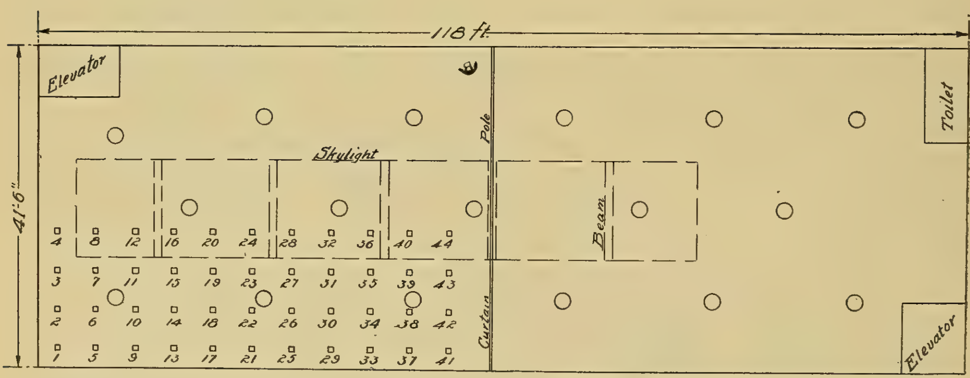
taken at night under the regular lighting conditions, as may be noted by the absence of daylight from the skylight and rear windows, the details of the pattern of the oriental rugs and tapestry coverings on the furniture is very distinctly shown on those parts which were in the focus of the camera. The exposure was fifteen minutes, and the results show a satisfactory intensity and uniformity. The walls, which are covered with red burlap, have a low reflection factor and therefore do not contribute appreciably to the illumination on the plane, as shown by the illuminometer values on the line of stations 1 to 40.

For the purpose of securing measurements which would permit of averaging the results, the room was divided into four equal parts; one of these quarter sections was again divided into forty-four squares of five feet each; the stations were then taken at the center of each square, as shown in Fig. 4.

The results, "Lumens per cubic foot of gas," "Average foot-candles on plane" and the equivalent electrical costs, were calculated on this area, 1,100 sq. ft., one-quarter the total consumption of gas being considered as applying to same.

It was necessary to furnish good illumination on the walls to a height of nine feet, but it was not required to have this illumination uniform, as pictures could be hung in such positions as to receive the intensity most desirable. The wall illumination varies from 3.5 foot-candles maximum opposite the fixtures to 2.5 foot-candles minimum. These readings are vertical values at a height of eight feet from the floor. Angle shades were used on the two arms toward the wall, and were not directed to the wall but to a point midway between fixtures, ensuring a better diffusion and absence of direct reflection of the sources of light from the surfaces of the pictures.

At the time the illumination measurements were taken this installation had been in use two weeks. The tests were made with the entire equipment of prismatic reflectors in use. Angle shades are used when it is specially desired to show pictures on any part of the wall. These were in use when the vertical measurements were taken. The consumption per burner was determined from the meter registration with thirty-six burners in use. It was not convenient to check the amount taken by the pilot flames owing




Samuel T. Freeman & Co - Chestnut St Phila Pa

FIG. 4.

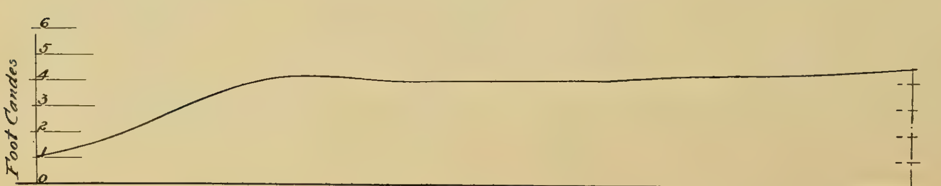



FIG. 5—ILLUMINATION VALUES ON LINE OF STATIONS FROM 4 TO 44.

to other lamps being in use throughout the building. Deducting the estimated consumption of these lamps, however, tends to show that the gas taken by the pilots was not excessive.

Following the taking of these measurements, the illuminometer, equipped exactly as when these measurements were made, was checked on a bar photometer against two different standard lamps. All the readings in the measurements taken, as well as those by which they were checked, were made by the same observer.

### DATA PERTAINING TO THE PROBLEM OF ILLUMINATION.

| | |
|---|---|
| Dimensions of room | 118 ft. x 41 ft. 6 in. |
| Height of ceiling | 15 ft. |
| Height to mantles | 12 ft. |
| Height of test plane | 3 ft. 6 in. |
| Height of mantles above test plane | 8 ft. 6 in. |
| Number of fixtures | 17 |
| Number of burners | 51 |
| Average consumption of burners, cu. ft. | 2.92 |
| Total consumption of burners, cu. ft. | 149 |
| Pressure in tenths | 17 |
| Total area of floor, sq. ft. | 4761 |
| Cubic feet of gas per sq. ft. | .0312 |
| Number of test stations | 44 |
| Average foot candles on plane | 3.26 |
| Lumens per cubic foot of gas | 104.4 |

### OBSERVED HORIZONTAL ILLUMINATION VALUES.

On Line 1 to 41.

| Sta. | Foot Candles | Sta. | Foot Candles | Sta. | Foot Candles |
|---|---|---|---|---|---|
| 1 | 1.26 | 17 | 1.85 | 33 | 2.13 |
| 5 | 2.27 | 21 | 2.48 | 37 | 2.29 |
| 9 | 2.24 | 25 | 2.35 | 41 | 2.27 |
| 13 | 1.83 | 29 | 1.69 | | |

On Line 2 to 42.

| Sta. | Foot Candles | Sta. | Foot Candles | Sta. | Foot Candles |
|---|---|---|---|---|---|
| 2 | 2.04 | 18 | 2.93 | 34 | 3.69 |
| 6 | 3.32 | 22 | 3.83 | 38 | 3.69 |
| 10 | 3.67 | 26 | 3.76 | 42 | 3.43 |
| 14 | 3.13 | 30 | 3.23 | | |

On Line 3 to 43.

| Sta. | Foot Candles | Sta. | Foot Candles | Sta. | Foot Candles |
|---|---|---|---|---|---|
| 3 | 1.88 | 19 | 3.78 | 35 | 4.15 |
| 7 | 3.59 | 23 | 4.27 | 39 | 4.62 |
| 11 | 4.08 | 27 | 4.15 | 43 | 4.52 |
| 15 | 4.03 | 31 | 4.15 | | |

On Line 4 to 44.

| Sta. | Foot Candles | Sta. | Foot Candles | Sta. | Foot Candles |
|---|---|---|---|---|---|
| 4 | 1.36 | 20 | 3.96 | 36 | 4.25 |
| 8 | 2.53 | 24 | 4.01 | 40 | 4.31 |
| 12 | 3.83 | 28 | 4.03 | 44 | 4.54 |
| 16 | 4.18 | 32 | 4.14 | | |

From the observations and results of the illuminometer measurements in this room an approximate factor may be secured, which should at least apply to installations of a similar character, i. e., large room, light ceiling and dark walls. With this factor we can determine the number of burners to install for a desired illumination in a manner similar to the use of the tables published for electrical sources giving the required watts per square foot, the rule being:

Watts per sq. ft.=foot-candles×constant (from table) and

Total watts=area×foot-candles×constant.

The constant for burners and equipment as here installed would be .01, and the rule:

Total cubic feet=foot-candles×area×.01.

For example, as shown in the table above, the average foot candle intensity is given as 3.26, and the area as 4761 sq. ft. To apply the rule: 3.26×4761×.01=155 cubic feet.

The burners installed consume approximately 3 cubic feet of gas per hour, and we therefore have 155÷3=51 burners required.

The point should not be overlooked that a rule of this character is of no value in determining the uniformity of distribution. The character of the distribution curve of the unit must be considered, and the illumination checked by point-to-point calculations.

The distance between the fixtures in this installation is approximately one and a half times the height, or the height is

equal to two-thirds the distance between fixtures.

In considering the question of a gas or electric installation on this floor many points came up, for with either gas or electricity new piping or wiring would be necessary. Owing to the fact that this floor is little used during several months each year, the total yearly hours' use is short, and would not exceed an average of one and a half hours per day. With electricity this would mean not less than 12 cents per kilowatt hour, with a possible 15 cents, or higher, considering minimum charges during some months. The installation of gas equipment, from estimates furnished by contractors, was fully one-third less than for a tungsten lamp equipment, and the maintenance, an important consideration either with mantle burners or tungsten lamps, did not alter the situation.

The question of heat, ventilation and the purity of the air in the room, was somewhat in favor of the gas. A consideration of structural conditions clearly shows that, with the large skylight area, which is amply supplied with ventilators, there would not be any appreciable rise in temperature and the heat would aid in securing satisfactory ventilation.

On the matter of the most important consideration, the yearly costs for illumination, the gas was found to be cheaper. From the results obtained, 104.4 lumens per cubic foot of gas, with gas at $1 per 1,000 and no minimum or readiness-to-serve charges, a tungsten lamp installation having an efficiency of five lumens per watt, which can be secured with clear prismatic reflectors where there are light ceiling and light walls, would have to be supplied with electricity at 5.19 cents per K. W. hour for equal cost. At an efficiency of four lumens per watt, as given in tables published (watts per square foot per foot candle, 0.25) for tungsten lamps with clear prismatic reflectors, light ceiling and dark walls, the rate should be 4.15 cents per K. W. hour. When this amount is compared with the probable central station rate of from 12 cents to 15 cents per K. W. hour, which this installation would have to stand, there was little room for argument or occasion for scientific salesmanship.

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SHOW WINDOW, KNOXVILLE (TENN.) GAS CO.

## An Object Lesson

The old saw about the shoemaker's children being always barefooted has too many parallels in gas company offices and show windows. If gas is good enough for the public in general to use for lighting, it is certainly good enough to be displayed in its best possible form in every place about the quarters of the gas company. Where a show window is available it offers an unsurpassed opportunity for the demonstration of window lighting in particular and gas lighting appliances in general, and this opportunity should be taken advantage of to the limit. In this respect the electric lighting interests have shown a keener appreciation of the advantages to be gained from catching the public eye. There are many notable exceptions to this rule, however, among which is the Knoxville Gas Company, a view of whose windows is shown herewith.

## Fixtures and Accessories

# Illuminating Engineering and Decorative Designing

By Albert J. Marshall.

The first point which I desire to bring out in this article is to generally request, nay, appeal, that the illuminating engineer and decorative designer will at least endeavor to see cause for each other's existence and not to feel that either of their respective fields of work is so sacred or intricately difficult as to make it sacrilegious or impossible for the other to tread thereon.

Cooperation — harmony — is the substance of success when two bodies are striving for the same general results, and in no field of work, to my mind, is there greater necessity for more earnest, hearty cooperation than in the art and science of illuminating engineering and decorative designing. Lack of cooperation sometimes denotes ignorance, sometimes egotism, and sometimes fear; but I am sure that no self-respecting, capable illuminating engineer or decorative designer wants the public at large to feel that he is ignorant, egotistical or fearsome; that he does not appreciate the necessity of considering his work in full detail; that he has such an exalted opinion of his own ability that he feels that his knowledge is supreme and final, which therefore does not require assistance of any nature, or that he fears the other person, if consulted and given an opportunity, through his greater ability, will encroach upon his field of work. But these opinions, I feel, will be shared by the public if early steps are not resorted to in order to obviate the petty, unnecessary, unfriendly feeling that seems to exist at the present time between these two elements.

Both the illuminating engineer and decorative designer are here to stay; both number among their ranks people of intelligence and standing, and the public now realize that neither illuminating engineering nor decorative designing is a mere whim, but that it deals with their very existence. They naturally want to place proper confidence in our abilities, which should cause us to do all in our power to stimulate such desire.

The illuminating engineer, by the study that he has given to the general subject of light and illumination, feels that the decorative designer is oftimes not competent to handle matters pertaining to anything but the most simple lighting problems, because he feels, and rightly so, that this subject—light and illumination—is one of such great depth and breadth that to handle same properly one must be a close student of all theories presented on same. The decorative designer, on the other hand, feels that the illuminating engineer is not competent to handle lighting problems other than the purely utilitarian sort. In other words, he feels that the illuminating engineer, being of a scientific train of mind, is unable to appreciate the beautiful things in life because he (the illuminating engineer) does not have what is ordinarily termed "good taste," and, therefore, should not attempt to specify lighting systems when such systems involve the use of "good taste," to say nothing of æsthetic principles. This, then, is the general "relationship" that seemingly exists between these branches of work which are so very closely related. There must be, and is, a common ground on which these two now seemingly warring interests might accept, and the fruits of such acceptance—cooperation—would unquestionably be of great value to the public in general.

Strictly speaking, to my mind, the competent illuminating engineer is, or at least should be, for all practical purposes, a man who, while perhaps not having the ability to actually make use of decorative designing as an applied art, does or should appreciate what is good and necessary in such work, and who has sufficient general knowledge of this subject to not only know its value but to be able to cooperate with its general use and to appreciate the value of a competent decorative designer. It is a poor rule that does not work both ways, and therefore the decorative designer should, and in some cases he does, appreciate the necessity of using artificial light in an intelligent manner, which, when all is said and done, is illuminating engineering. For either the illuminating engineer or the decorative designer to say that the other is incompetent or incapable of appreciating their respective fields of work, or that he should not handle any but very restricted lines of work, is to state that he alone is capable of assimilating sufficient knowledge to intelligently carry out the work. I personally feel that any assumption of this nature reflects ignorance and egotism and that before any good general results can be obtained, which results rely on the cooperation of the two elements herein referred to, that a different foundation must be laid. A point to be considered in this connection is that there is as much reason to believe that the illuminating engineer can undertake work involving the use of applied design as it is to feel that the decorative designer can undertake work in which use is made of illuminating engineering principles, for is not the decorative designer, who uses artificial light properly, an illuminating engineer, and vice versa?

In order that we may more fully understand the reasons why this seemingly unfriendly feeling does exist, why there should be no cause for same, and why the illuminating engineer and decorative designer have so much in common, it will be necessary perhaps to analyze their general interests.

A comparatively short time ago a few men of scientific minds began to realize that artificial light was being, in general, wrongly used. These men, feeling that the economical side offered a field for their efforts, began to devise means of eliminating the great waste. The result of much experimental work and research along scientific lines was that the remedies that were suggested were closely related to science rather than to art. When it was demonstrated that these remedies could be put into practical use, and that they would be of much value in effecting a general saving, use was first made of them in work wherein the utilitarian side was of prime importance. So great were the desirable results obtained from this work that these new principles, without much modification to suit the different conditions, were embodied in lighting systems, wherein the æsthetic side should have been given the greatest consideration, the result being that, while economy was effected, appearance, to a measure, was sacrificed. The cause or reason for this act or practice at that time was largely due to the fact that the people who had made use of these then new principles had, we will say, only the purely scientific side of the matter in mind when the work was attempted, and the results naturally left something to be desired. About this time, those people who had appearance primarily at heart arose to the occasion and forcibly stated that the illuminating engineer had demonstrated his inability to successfully cope with such class of work, and therefore, in the future, should leave it strictly alone.

As before stated, the first of the so-called illuminating engineers were primarily of utilitarian minds. They had, up to this time, little or no need of using æsthetic principles in their work, much in the same way that the decorative designer had made little or no use of illuminating engineering principles in his work. Among these pioneers of yesterday were men, though, who, in general, do appreciate the beautiful things in life, but who, up to this time, had given most all their thoughts and energy to other desirable and necessary features of their work; these were men who know the value of harmony, and who thoroughly appreciated the fact that other than the purely scientific part of such work should and would receive due consideration. They, realizing the position that the fully qualified illuminating engineer would eventually hold, began to fit themselves accordingly, the result being that they became students

of architecture and decorative designing, as well as endeavoring to develop in themselves what is ordinarily termed "good taste."

The outcome of such study and observation being that today there are a few men in the illuminating engineering profession who are thoroughly qualified to handle in all detail any lighting installation that may be brought to their attention, no matter for what class or period of architecture or treatment the lighting installation may be for. These men, contrary to the opinion sometimes held, and oftimes expressed by some critics, thoroughly appreciate some of the finer points in æsthetics, although they, as a rule, do not make such points the subject of their talk. Such men, I grant, are few in number, and necessarily so, because the profession they represent is extremely young, but they do exist, and their services may be obtained, provided a compensation in proportion to their ability is offered. This condition of affairs, as to ability, prevails in the architectural and decorating world, as well as in the profession of illuminating engineering and in other walks of life.

The mistake that a great many people have made in judging of the value of illuminating engineering work is to judge almost entirely the work of some so-called illuminating engineer, who, through what general experience he has obtained as a lighting solicitor or seller of lighting accessories, has assumed the title of illuminating engineer, and who will oftimes, on the spur of the moment, give an opinion on a lighting installation which would be given only after due thought by the competent engineer. This type of so-called illuminating engineer helps to stimulate the impression that the illuminating engineer is a person purely of utilitarian mind, and one who thinks only of how much current, dollars and cents, and lighting fixtures can be saved. Such assumptions are incorrect if applied to the competent engineer, for such an engineer first of all understands the cause and reason for the existence of light; second, the various kinds and forms of accessories for artificial light, which are almost without number; third, the many, many uses to which these almost countless forms of artificial light may be put; fourth, the utilization of artificial light in such a manner that not only the greatest possible economy may be obtained but that the installation when completed will conform in all detail to the general style or treatment of space in which same is placed, so that the lighting system in connection with its general surroundings will be in perfect harmony. He realizes, for instance, that a lighting fixture is just as much a part of the treatment of the space in which it is placed as the drapery, furniture, carpet, wall paper, etc., although there are some critics who will not give some illuminating engineers the credit of looking at the work in this manner. Fifth, that artificial light must be acceptable and not objectionable or injurious to the eye. This last point is of extreme importance, inasmuch as without the medium of the eye all effects obtained would be for naught.

The decorative designer, on the other hand, should, and must, if he expects success, be an illuminating engineer, or at least appreciate the value of same. For instance, I feel that it is an accepted fact that the lighting fixtures are just as much a part of the decorative scheme or general treatment of space as in any other object placed in the room; and how is the decorative designer to make fixtures blend with the surroundings, and at the same time make them sensibly efficient, if he does not understand in detail not only what one light source will do but what all light sources will do with their various equipments so that he may choose what is best suited for the space in question. Is it not desirable and necessary to have artificial lights so arranged and equipped as to bring out the proper color schemes and general treatment of space; to cast shadows in proper directions; to give desirable dimensions; to appear to good advantage in the daylight as well as in the evening, and to be efficient not only at the time of installation but to be made adaptable to future developments in the industry, for at this day the changes are so great and rapid and of so much importance that, if one is not careful, a lighting system which may be considered of value this year may almost be valueless next year? One way of eliminating this possibility of misuse is to be in a position to anticipate developments, and this only

done by being a close student of the art and science.

Let us for a moment consider, in part, the weight of color and see what an all-important part this question in illuminating engineering and decorative designing plays. Color is of vital consequence to the decorator. He decorates a space in a manner calculated to give or reflect a certain general tone or hue; perhaps he has worked for this general color scheme under one form of illuminant or another, or in his studio under various tones of daylight. We will say, for instance, that he designs a scheme of decoration in a studio which is situated on the north side of the building; that daylight is permitted to penetrate same through a window situated on the same side, which is composed of ground glass, an almost ideal condition, and that the idea when worked up will be embodied in a space similarly located in a building. The result—application of such a scheme, when observed under daylight conditions, we will say—is quite acceptable, in fact it may be very flattering. Night comes; artificial lights are lighted; the objects used in the treatment of this space, we will say, assume a different hue, or color, as well as different dimensions, and the direction of shadows are changed, owing to the fact that the natural and artificial light comes from different points, to say nothing of the general effect that may be produced on the eye. Is this change beneficial or detrimental to the decorating scheme? The designer, by being a student of illuminating engineering principles, could have anticipated such an effect and therefore would have designed his lighting system so as to bring about a lighting effect which would not have distorted his scheme. He also would have considered the desirability of making the lighting installation as economical as possible.

One oftimes hears the statement made that economy of operation in a given space is not to be considered. I, however, do not agree with this statement. What I do believe in is this; that, when desirable, æsthetics should be given chief consideration and *then* make the system as economical as possible. It is oftimes easily possible for a lighting fixture to be efficient, economical and efficacious, while again there are times when the fixture is to be so much an ornament that economy becomes of very minor importance. The illuminating engineer and decorative designer does, or should, know where the line should be drawn.

There are signs, and unmistakable signs, that the public is beginning to pay attention to what may be ordinarily termed "harmony" in the declaration of their buildings, even in the home of a family of moderate means. An illustration of this tendency is in evidence in the better class of our larger stores, where various types of rooms are arranged and thoroughly equipped in such a manner that beauty and utility are reflected from them, which causes much interest on the part of the public. These examples, together with the admirable work done by architects and decorative designers, is beginning to tell, and today the average person, in purchasing objects for a given space, will endeavor to solicit competent advice in this direction. Formerly, and even to a measure today, it was, and is, not an uncommon thing to see a person, in making a selection of various objects to be placed in a space, to make such selection from a large number of different establishments under a likewise number of different types of illuminants, all perhaps giving a different color value, the result being that when same are placed in the space for which they are intended, there is more or less of a clash or discord.

Likewise there is a decided tendency on the part of the public to understand that light, to a large measure, can be controlled, and that if handled in an intelligent manner their interest will be well served. It therefore behooves both the lighting engineer and the decorative designer to understand in practical detail the vital points entering into this broad field of work, so that in ordinary cases they can, without soliciting each other's help, recommend a desirable treatment; further to know when it is essential that the other's finer knowledge should be called in to assist. When the public look to us for advice, much in the same way that they would consult with a doctor, it is not only desirable but our duty that we should give to them honest, intelligent assistance.

# Theory and Technology

## Plain Talks on Illuminating Engineering

By E. L. Elliott.

### No. 15.—Calculating Illumination by the "Flux of Light" Method

There are many cases in the mathematical engineering of illumination in which it is convenient to consider light as a flux and base the calculations upon its measurement as such. Before taking up the purely mathematical treatment of the subject it will be well to come to a clear understanding of the meaning of the term "flux," as used in connection with light, and the several units used in its measurement. Flux is literally the act or process of flowing. As applied to light the term cannot be taken literally, for flowing is, strictly speaking, a property of fluids, and the physical thing which we call light is not a fluid but only an action or motion. The word "flux," therefore, as used in connection with light, signifies to the continuous passage of motion from the source outward.

When a pebble is dropped into still water a motion of the water, in the form of circular waves, spreads out in every direction over the surface. If pebbles were dropped in rapid succession there would be a continuous train of waves spreading out over the water; when the pebbles stopped falling the production of waves would cease. What we call a light-source is a substance which is continually setting up waves in the ether—that mysterious something which fills all space—but, instead of these waves spreading out over a surface in circles, they spread out in every direction in space, and may be conceived as concentric spheres instead of circles. So long as these waves are set up at the source, they continue to spread out into space, and the continuous spreading out of these waves is what constitutes the flux of light. It will be helpful in many waves to conceive of light as a continual flow or passage of waves through all space surrounding the source, rather than as a mere effect upon objects in the path of the waves. Keeping this conception of the nature of light in view, let us

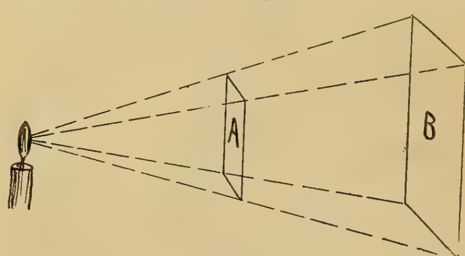



FIG. I.

consider some of the various photometric quantities. The fundamental quantity in all measurement of light is intensity, popularly known as "candlepower." This measurement is made by observing the intensity of illumination produced upon a matt white surface of small area, and may be considered as determined by the

"flux density" upon the observed surface. For purposes of illustration only, we may compare the flux of light to the flow of gases, the rate of flow being considered always the same, since the rate at which light travels is invariable. Let us see how the analogy will serve to explain the "law of inverse squares." Flux density may be likened to the density or pressure of flowing gas. Let us imagine a gas of given density starting to flow through the apex of a hollow pyramid, as Fig. 1, As the gas proceeds in its course it will constantly expand to fill the increasing space and decrease in density proportionally. Thus its density, when it has reached the point A in its course, will be proportional to the area of that space, and when it reaches the point B it will have expanded to fill the space indicated. It can easily be shown, either by a scale drawing or a mathematical demonstration, that the area of A is four times that of B. Since the gas has expanded to cover four times the space, its density will be of only one-fourth as great; that is, having proceeded twice the distance, its density has been reduced to one-fourth, and so on for other distances.

Let us now apply the analogy to intensity of illumination commonly expressed in foot-candles. This quantity may be considered as density of the gas in contact with an intercepting surface, and is therefore also a flux density. The density of our imaginary gas at any point in its flow will clearly depend upon its density at the starting point, and the distance which it has flowed, provided it has flowed through a constantly expanding passage represented by a cone or pyramid whose sides are radii of the same sphere. What then is the difference between the intensity of *light,* expressed in candlepower, and intensity of *illumination,* expressed in foot-candles? Simply this: in the former no fixed intensity or flux density is given, it always being understood that the illuminated surfaces are equally distant from the two respective light-sources, i. e., the standard light and the measured light. Under these conditions the intensity or flux density upon the surfaces of comparison will depend entirely upon the density of the gas at the starting point: intensity of *light,* as candlepower, expresses the flux density at the source, while intensity of illumination, expressed in foot-candles, is the density of the gas in contact with a given surface, and gives no information as to the density of the flow at its starting point, since the density on the given surface will depend upon its distance *from* the source as well as its intensity *at* the source.

The remaining measurement to be considered is light considered as a quantity, which is quite a different thing from intensity. Continuing the analogy: The quantity of gas—that is, the actual amount of substance—will depend upon the area of the orifice through which it flows and the density of the gas at the orifice; so, light, considered as a quantity, will be measured by the extent of surface which it covers and the flux-density (intensity of illumination) upon that surface.

Light as a quantity has been commonly expressed as spherical candlepower. Another unit of measurement which has come into use, and which is advantageous in certain cases, is the "lumen." Taken one spherical candle as the unit, we may consider that the imaginary gas starts to flow at the center and expands freely in every direction so as to completely fill the entire space around its starting point. Considering its original density as one candlepower, the flux-density at any point one foot distant from the source will then be one foot-candle; that is, if the imaginary light source were placed in the center of a hollow sphere of one foot radius, it would illuminate the entire surface with one foot-candle intensity, and the total quantity flowing from the source would be proportional to the entire area of this surface multiplied by the flux-density or intensity upon the surface. One spherical candle is, then, the quantity of light (flux) required to illuminate the surface of a sphere of one foot radius with an intensity (flux-density) of one foot-candle. The surface of a sphere of one foot radius is a trifle over 12.5 square feet.

Now, suppose that, instead of considering the whole surface of the sphere, we take only one square foot of the surface, which may be considered the area of the orifice through which our gas is issuing with the same flux-density, we shall evidently get only $\frac{1}{12.5}$ as large a quantity as we would have if the flow were over the whole sphere. This quantity is called the

lumen. Mathematically defined, the lumen is the quantity of light received upon a surface one foot square, the intensity of illumination on which is one foot-candle. The spherical candle is therefore 12.5 times (exactly 4 $\pi$ times) as great as the lumen.

The idea of flux may help us to a better understanding of that much misunderstood term, "mean spherical candlepower." Actual light-sources, as is well known, give out different intensities of light at different angles. For simplicity, let us consider a source which gives out an intensity of sixteen on the horizontal, eight on the vertical and varying intensities between. We must imagine that these figures represent the relative density of our flowing gas as it starts to flow in the given directions; that is, the gas that starts to flow out horizontally is twice as dense at the starting point as that which flows vertically, and so on. Let us consider the flow between the horizontal and 15 deg. below: It spreads out so as to cover an area represented by a zone around the sphere 15 deg. wide, starting with the

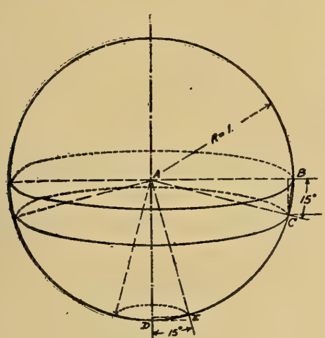


FIG. 2.

equator, as shown in Fig. 2, from B to C. The flow vertically within an angle of 15 deg. covers only the small circular zone 15 deg. wide around the pole, D E. The density of the gas (flux-density) at the two surfaces, or orifices as we may consider them, will therefore be in the inverse ratio of their areas; that is, the larger the area the less the density. It will therefore require a proportionally greater quantity of light, that is, a larger flux, to maintain the same flux-density on the larger area than it will upon the smaller, and we can divide the entire sphere into zones in a similar manner, each of which will have a different arc and receive light having a different intensity to start with. Now, we can imagine the total quantity or flux of light evenly distributed so as to produce the same flux-density or intensity of illumination at every point on the sphere. This would require a mean or average intensity somewhere between the eight and the sixteen. It would evidently not be the arithmetical average of the intensities at the different angles, because the intensity near the horizontal represents so much larger area of surface. It is not necessary, however, to conceive the mathematical relation in order to imagine such an average intensity, and this average intensity or flux-density is what is meant by "mean spherical candlepower."

Since "mean spherical candlepower" thus represents a flux-density which is equal in every direction, the total quantity of light or flux given out will be measured by this intensity or flux-density, and hence the term spherical candle may refer to quantity of light as well as to density, and, in fact, is generally so used and understood.

The spherical candle as thus commonly understood, i. e., as a measure of quantity, or flux, differs from the lumen, the newer, and supposedly more scientific unit, only in magnitude, and in the ratio of the surface of a sphere of one foot radius to a surface of one foot square. Simply defined, the spherical candle is the quantity or flux of light necessary to illuminate 12.5 (4 $\pi$) square feet with an intensity of one foot-candle. The lumen is the quantity of light required to illuminate one square foot of surface with an intensity of one foot-candle. It is therefore plain that lumens and spherical candles are convertible into each other by simply multiplying or dividing by 4 $\pi$ or 12.5. The term spherical candle is made up of two words, whereas the term lumen is but one, and the term spherical keeps in the mind the entire surface of a sphere, and therefore requires little better trained imagination to conceive of the quantity of light represented than does the lumen, in which we have only to think of a square foot of surface, and a foot-candle of intensity.


## The Illuminating Engineering Society's Responsibility to the Profession

The question, "What is an illuminating engineer?" has been so frequently answered that the term is now pretty generally understood, even among the "laity." But the question, "*Who* is an illuminating engineer?" is far less easy to answer. The title, "illuminating engineer," carries with it, in accordance with the general understanding of similar titles, a comprehensive and expert knowledge of the subject of illumination. Since expert knowledge commands a compensation beyond that of the common artisan or laborer, and since the results of such expert service are of greater importance, financially and otherwise, it is generally considered necessary that those professing such special knowledge shall possess credentials assuring the genuineness of their claims. The most common form of credential is a diploma from some recognized and chartered institution of learning. Membership in a scientific society is also generally considered a credential of a similar order. In the higher type of such societies membership signifies not only academic training, but marked ability in the application of such training.

Up to the present time there is no regular institution of learning in this country that is giving special instruction of such nature as to justify the recipient taking the title of Illuminating Engineer. There is, however, an organization styled The Illuminating Engineering Society. From the name of this society the general public will naturally and rightly assume that its membership is made up of illuminating engineers. To be sure, there is a nice distinction in the title; and "Illuminating Engineering Society" is not the same thing as a "Society of Illuminating Engineers." This distinction was purposely made by its founders; but such niceties in technical terms will never be noticed by the public. Nor will the purpose of the Society, as expressed in the preamble of its constitution, lead to any general enlightenment. The fact that the original purpose of the organization was to bring together all of the various interests in the lighting field, and thereby secure a more united and harmonious effort toward the establishment of illuminating engineering as a distinct branch of science is a piece of "inside information" of which the public have no knowledge.

That membership in the Society is a mark of distinction is further impressed upon the public by the membership badge, which any member who has $3.00 to spare can obtain. As a still further evidence of distinction, any member can obtain, by the payment of $1.00, a handsomely engrossed certificate of membership. Thus, the Society has utilized all of the means common among the most exclusive scientific bodies of impressing the outsider with the distinction attaching to membership. For the assumption by the public that its members are illuminating engineers, in the full meaning of that term, the Society must accept full responsibility. The Society, however, has never claimed any such distinction for its members, and in fact would strenuously disclaim any such intentions if really brought to book upon the subject; nor would the great majority of its members pretend to such comprehensive expert knowledge as to justly entitle them to be called illuminating engi-

neers. On the other hand, membership in the Society, which is practically open to any one who has never been indicted for any criminal offence, and who has ten dollars to spend for dues and fees, offers a dangerously easy means for those with easy consciences and limited knowledge and experience to pose as illuminating engineers.

That the science and art of illuminating engineering should be placed upon the high ethical and technical plane of the other special branches of engineering, is of paramount importance. The Illuminating Engineering Society is a means to this end,—not an end in itself. To the extent that it furthers this important object it is worthy of all support and commendation; but if it in any way works contrary to this main purpose, to that extent it is deserving of extinction. We believe that the Society has accomplished a very great deal of good in promoting the cause of illuminating engineering; but we also believe that its present position is anomalous, and fraught with serious danger to the dignity and progress of illuminating engineering as a profession.

It is time that a clear distinction be made between illuminating engineers and those who in some collateral way are interested in the subject of illuminating engineering. The distinction is by no means invidious. There are many amateurs of art who take a keen interest in its various developments, but whose sense of justice would be offended if they were called artists; it is their pleasure and their privilege to promote the cause of art and the welfare of artists by their interest and sympathetic co-operation. So likewise there are a great many people who, for one reason or another, are deeply interested in the general subject of illumination, and anxious to see it raised to the dignity of a science and art. The co-operation and assistance of such is not only welcome, but is invaluable; but it is neither just to them nor to those whom it is their special purpose to assist, that they be themselves classed as illuminating engineers. So far as we know, there is very little evidence of attempts to use the distinction of membership in the Society as a means of personal aggrandizement; but as the demand for illuminating engineers increases the temptation to such action will become proportionately stronger; and human nature is bound to yield to temptation to a greater or less extent. The Society will lose none of its prestige nor popularity by thus distinguishing between the professional illuminating engineer and the mere student or amateur of the subject.

## The Annual Meeting of the American Gas Institute

The third annual convention of the American Gas Institute was decidedly successful. It would have been a surprise to those interested if it had been otherwise. The Institute represents the technical and scientific side of the gas industry of this country, and the importance of its work is certainly great enough to insure both a high order of scientific talent and attainment, and a keen interest in the results produced.

The most important part of the proceedings, so far as illuminating engineers are concerned, was the paper of Mr. Litle, on "Better Methods in Gas Illumination," and the discussion which followed. The presentation of this paper, the close attention which was given to its reading, and the interest shown in the discussion, are significant facts, showing that the gas interests can no longer be accused of a total neglect of the importance of illuminating engineering to their welfare.

Notwithstanding the undoubted success of the Institute along the lines which it has been working, it seems to us that the gas interests as a whole make a serious mistake in separating the commercial side of the industry from the technical. While both the Institute and the National Commercial Gas Association are working out their individual and respective destinies, the sum total of their accomplishment is unquestionably less than it would be were they united into a single organization. The sale and production of gas are so intimately connected that they cannot be rigidly separated without a distinct detriment to each. The more the commercial end knows of the scientific end, the more effective will be the work of each. Besides, the very important fact must not be lost sight of, that the personal acquaintance of all those whose energies are directed toward a common end is

a positive source of strength. The National Electric Light Association is an admirable example of the points which we are seeking to make. The Institute and the Commercial Association united would form an association comparable in every way with the National Electric Light Association, which can hardly be said of either of the two organizations as they exist separately today. Our earnest advice therefore to both of these gas associations, which have amply justified their existence, is: "GET TOGETHER."

## Candle-Power Standards and the Gas Industry

The American Gas Institute is still struggling with the problem of a standard light source. Scientifically, the question is an interesting one—perhaps not the less so because there seems to be no conclusion to it. Practically, the matter seems to us likely to prove a case of "Love's Labors Lost." From present indications it looks very much as if, by the time such a standard is reached, if not long before such time, its use will have entirely lost its present importance.

As conditions exist today, the rating of gas commercially on the candle-power value of the best luminous flame obtainable is inadequate, illogical and unscientific. Gas today is used for producing heat, and that only; at any rate, other uses are so small, or could readily be made so small, as to be incomparable in comparison. To begin with, probably one-half the gas sold is used for direct heating purposes, chiefly cooking, and it is the calorific value of the gas that is of importance. The other half of the gas sold is used for producing light, and the greatest amount of light can be produced from that gas which will give the greatest amount of heat, the heat being utilized in the well known mantle burner. To be sure, there are many flame burners still in use; they are relics and really have no excuse to live. Every one of them could be replaced with a mantle burner to the great advantage of the consumer.

Why, then, all this arduous toil to obtain a standard for what there is no occasion to measure? Wisconsin has already pointed the way, in which other states will doubtless follow, and in which the gas companies should give their assistance. In that state the candle-power rating has been entirely abandoned, and the calorific value is the only standard which has legal authority. It is a significant fact that a serious movement has begun looking toward the sale of coal on a basis of its heat value rather than upon its mere weight.

Let the gas interests "get busy" with their calorimeters and leave the candle to light their grandmothers to bed.

## A Standard White Light

All the recent improvements in light-sources have laid more or less stress upon the increased "whiteness" of the light. The "nearest approach to daylight," and "absolute sunlight quality" are phrases that have been frequently used in connection with the newer lights. The fact that these claims have a large degree of foundation in fact has attracted attention to the question, What is white light? Perhaps the most elaborate series of experiments ever carried out relative to this question were those conducted by Prof. Nichols, the results of which were reported in a recent paper contributed to The Illuminating Engineering Society. Prof. Nichols, however, is only one of numerous experimenters in this line, all of whom have arrived at somewhat different results.

It is a well-known fact, though one not yet so fully understood by the general public as it should be, that the quality of daylight varies through enormous changes from dawn to dusk, and furthermore undergoes extreme variations within short periods during the day. There is a greater difference in the actual color composition between the light from a clear blue sky and that received through murky clouds than there is between the colors of the most widely different artificial light-sources. The quality of any color depends upon the composition of the light in which it is viewed. The apparent shade or tint is therefore quite analogous to specific gravity, and might with propriety be called specific color; that is, its

color as compared with the color of a specific light.

The discovery of the analine dyes has made a complete revolution in the whole practical aspect and importance of color. In variety and purity of colors the products of the modern dye house are so far beyond anything previously attained as to render all former color effects mere daubs and blotches by comparison. Almost equal progress has been made in every other industry in which color effects occur. The question of color therefore has both a commercial and esthetic importance to-day enormously greater than at any previous period of history.

Taking the two facts together; that is, the importance of color in art and industry, and that color is a relative quality, the importance of establishing a standard white light becomes apparent. The extreme variability of daylight manifestly renders it entirely unsuitable for use as a standard. It would be quite as logical to take a patch of the sky as a standard of intensity, or "candle-power," as to take daylight as a standard of whiteness. The elaborate researches of Prof. Nichols and others, however, have furnished a basis for the foundation of a standard whiteness. The "average daylight" values obtained will furnish at least a reliable guide.

The spectroscope has served a useful purpose in the hands of trained scientists in the investigation of color, but of far greater practical importance in reducing the subject to a simple working basis is the instrument worked out with such consummate skill and ingenuity by Mr. Frederick E. Ives, to which he has given the appropriate name, Colorimeter. Briefly stated, this instrument affords accurate visual means on analyzing all possible colors and expressing them numerically by three numbers which represent respectively the proportions of red, yellow and blue, which go to make up the color. As will be at once inferred from our previous statements, the successful operation of this instrument depends upon the use of a standard white light. Fortunately the instrument itself affords the readiest means of establishing such a standard. Two methods are at present available for the production of a standard white light; first, the carbon-dioxide tube of Mr. D. Macfarlan Moore, and second, the acetylene flame with a portion of its yellow rays quenched with blue glass. As a primary standard the Moore tube apparently has no competitor. It requires no screen, which introduces a source of variability and error, and the different conditions essential to uniformity are apparently easy of exact regulation and reproduction. The production of such a standard of color is a distinct and important gain to the science of photometry and illumination; and if Mr. Moore had never accomplished anything more than this, he would be deserving of a place in the front rank of investigators and inventors in the domain of light. The acetylene flame has the advantage of being very much easier to produce, and of being more portable. It is therefore valuable as a secondary standard. The only thing required is the selection of the proper color of glass to use as a screen, and by means of the colorimeter and the Moore carbon-dioxide tube as a primary standard, the selection of such a glass is simply and accurately determined. The establishment of an almost theoretically perfect primary standard of white light, and a practical and easily obtained secondary, or working standard, together with the perfection of a colorimeter by which all colors are expressable as numerical values, constitutes a step in the scientific development of the science of light, the value of which can hardly be overestimated.

## An English View of Illuminating Engineering

Our English contemporary, the *Electrical Review,* takes occasion in a recent issue to explode a peal of thunder at the illuminating engineer and all his works. The editorial in question refers to the illuminating engineer as first seeing the light of day in America, "where the cult of the utilitarian is carried to the extreme." It then infers from recent extracts in the American technical press that the illuminating engineer has struck a snag in the shape of æsthetics; for, "surprising though it may be, in America, where nature is so colossal and man so poorly imitative, there is yet a substratum of æsthetics." We also learn that "the

architect has revolted against the scientific methods of the illuminating engineer, and has told him not to interfere with that which is holy."

It is difficult to obtain a true perspective of events across the seas, and we must not take too seriously the distortions of American conditions as seen by our English friends. Our contemporary has apparently been viewing us through a celestial telescope and has mistaken the inverted image for the true one. The plain fact is that the architect has run up against the illuminating engineer and has discovered, either quietly by his own observation, or by the more jarring prods at the hands of his clients, that putting in lighting installations that are antiquated, inefficient and half useless can no longer be justified by any specious argument as to their æsthetic harmony with the building, nor responsibility for their glaring failure to fulfil the prime purpose for which they are intended be shirked on to the electrical engineer or fixture manufacturer.

The demands of the public for the results of the science of illuminating engineering are producing cranial reductions in the megacephalous variety of the species architect which are naturally somewhat painful, and that an occasional groan should escape is to be expected. Such wails and protests as emanate from the architectural profession against illuminating engineering are consoling symptoms to the illuminating engineer, indicating that the progress of his profession is making itself felt. To be sure, such protests come only from the fossilized portion of the architectural profession; that portion which represents growth and progress has accepted the illuminating engineer at his true value, namely, as a valuable assistant and co-worker.

While America may be responsible for naming the profession, the thing itself which we call "Illuminating Engineering" received its first formative processes in England. Mr. A. P. Trotter's splendid pioneer work in developing the methods of calculating illumination, and his plea for a more rational use of light, constituted illuminating engineering of a high order. In fact, illuminating engineering is only another example, of which there are numerous others, of a valuable new idea being conceived, and its theoretical aspects worked out, in Europe and then perfected as a practical commercial factor by the "utilitarian" American.

The closing paragraph of the editorial, however, gives us the real animus of the views of our contemporary, and the preamble should be read by the light of this paragraph:

"Turning now to the British aspect, it is, perhaps, a pity that the science (it is not worthy of the name) of illuminating engineering did not arise before the days of metal filament lamps. There was then plenty of scope, from both the consumer's and the station engineer's points of view, for a more efficient use of electric light. The former would have welcomed any suggestions for reducing his bill, whilst the latter would have been able to employ the new ideas for business getting. But, alas! the poor station engineer has worry enough now with the reduced revenue caused by the new lamps, without the additional burden of illuminating engineering to accelerate his speed towards the gulf that is yawning before him. Therefore, however much we may sympathize with the idea of cheap light, it is necessary to tread warily lest, by grasping after the shadow, we lose altogether the substance. For this reason it is impossible to do more than to take a benevolent interest in illuminating engineering at the present moment, in order that the great electric supply industry may have time to recover from the blow at its vitals which it has received from the metal filament lamp. How soon this will be depends on the perspicuity of directors and committeemen in regard to the system of charging. But that is another tale. For two reasons, then, there is something to be said for the American attitude so far as this country is concerned; but we do not doubt that when illuminating engineering can make legitimate progress in this country, it will work hand in hand with art."

As we see it from this distance, electric lighting in England is today, and always has been, on the defensive, with the odds against it, in competition with gas. Why it should continually take this attitude is an unsolved mystery to the American. From our standpoint it appears that if the electric interests would spend half the energy that they now devote to showing up the shortcomings of gas light to a positive and aggressive campaign in exploiting the advantages of the electric light, they would find themselves in a far more prosperous and less humiliating position.

The confessed purpose of illuminating

engineering is to produce maximum results at minimum expense. The mere mention of a reduction in the cost of lighting evidently strikes terror to the hearts of our British electrical friends. What a contrast between this attitude and that of the American! Let us take a single example. It is well known that in the majority of American cities the gas and electric lighting interests are either combined into a single corporation or at least so dominated by the same financial interests as to preclude actual competition. But there are a number of important exceptions to this rule, among which is the city of Boston. Furthermore, Massachusetts has for a long time had a state commission having and exercising authority over electric lighting companies as to rates and service. Whether from this cause or from purely selfish motives, or from both, the lighting company of that city has reduced its rates practically one-third within five years, the last material reduction having taken place last July. Every form of higher efficiency electric lamp has also been very thoroughly exploited in this country.

Here, then, is a combination of every element which would tend to produce a reduction of income from lighting, namely, actual and keen competition with gas, a general reduction in rates, and the use of higher efficiency light sources. And what is the chief means which this company has taken to recoup this loss? Illuminating engineering. It has retained the services of some of the most experienced and competent illuminating engineers in the world, and in order that it might have the advantage of every possible source of knowledge, commissioned its leading engineer to make a trip to Europe during the summer to study foreign methods. During this time the company conducted an extensive and expensive advertising campaign in the daily press devoted exclusively to advising the public of its Illuminating Engineering Department and its desire to give the best possible service to its patrons. As might be expected, the gas company promptly checkmated this move by establishing an Illuminating Engineering Department and advertising it in the daily press.

Now the managers of the Edison Electric Illuminating Company of Boston are neither children nor visionaries; the past record of the company is sufficient evidence of that; and when they pin their faith in illuminating engineering as the one method of compensating for the reduction in the individual bills of its consumers by securing additional customers, and spend thousands of dollars in maintaining a department and advertising its services, it may be safely assumed that the move has not been undertaken without the mature and careful deliberation of some of the shrewdest financial heads in the electrical industry today.

To be sure we have only a "benevolent interest" in the welfare of electric lighting companies in England; but illuminating engineering, whether in America, Europe, Asia or Africa, is of very material interest to us; science is not national, but world-wide. Furthermore, there may possibly be some dark corners of the American continent in which these remarks will point a moral.

## Unethical Illuminating Engineering

"Unethical" is a soft-sounding word, and less likely to give offense than the "much shorter and stronger word" which expresses the same intent—"fake." We referred in our last issue to illuminating engineering of this stripe, in reviewing an article by Mr. Norman Macbeth in a recent issue of the *Dry Goods Economist.* Our contemporary, *Selling Electricity,* editorially takes Mr. Macbeth to task for this article, stating that the writer "takes occasion to knock every class of illuminating engineers except his own class," and that "it is rank injustice to a large body of honest and earnest men, who, having commercial affiliations, are faithfully striving to improve lighting conditions and to place the profession of illuminating engineering upon a solid foundation."

It strikes us that our contemporary has absolutely misinterpreted and misstated the purport of Mr. Macbeth's article. Mr. Macbeth has not a word of censure for the real illuminating engineer, nor for *bona fide* illuminating engineering, but very properly holds up to scorn and ridicule the pretensions and devices of a varied class of individuals who are trading upon the ignorance of the public and the

good name of illuminating engineering to serve their own sordid purposes of gain; and the quicker this sort of thing is "knocked" into insensibility the better it will be for the public in general and the illuminating engineering profession in particular.

The reflector fakir, who, by showing the bright spot of light immediately under a highly concentrating "hood," induced the innocent consumer to pay him a monthly tribute for the privilege of having his total illumination cut in half, has left his trail in nearly every state in the Union. Besides his particular victims there are two other classes that have suffered from this sort of "illuminating engineering"—the reputable reflector manufacturer, who legitimately employs illuminating engineering talent in the design and sale of his wares, and the professional illuminating engineer, whose services are discredited by the works of his spurious imitator.

A certain amount of illuminating engineering science is applicable to the design and construction of lighting fixtures, and it is highly desirable that fixture manufacturers and architects realize this fact and put it into practice; but this desirable condition will in no wise be hastened by such exploits on the part of salesmen as Mr. Macbeth instances, in which some sort of a "lier" was hung up in a merchant's show window squarely in the eyes of the passers-by, the merchant failing to grasp the meaning of the engineer-salesman, that "what he wanted was to show his goods."

Again, "'tis true, 'tis pity, and pity 'tis, 'tis true," that through overzealous and mistaken efforts to serve their employers, lighting company solicitors have occasionally gone beyond the bounds of professional ethics.

That the manufacturers of lighting apparatus of all descriptions, and the producers of luminants, should employ illuminating engineers is not only strictly ethical and legitimate but highly praiseworthy. By virtue of such employment, however, such engineers occupy a different position from the independent or consulting illuminating engineer. The case is precisely analogous to that of the electrical manufacturer who employs electrical engineers. Aside from their part in the design of the apparatus, it is the legitimate province of such engineers to see that their apparatus is so installed as to give the best possible service to their customers, and they are not only not called upon to exploit the merits of other makes of similar apparatus but would be guilty of a serious breach of business ethics in so doing. So with the illuminating engineer in the employ of a commercial enterprise: it is his business to see that the products of his employers are installed to the best advantage, and, within the well recognized limits of commercial ethics, to promote the sale of those products as far as possible. It is the necessary existence of such engineers that creates the position of consulting engineer, whose sole duty is to his client, who is a buyer instead of a seller. The engineer for this, that and the other manufacturer may properly present the technical merit of his particular wares; it is for the consulting engineer to advise the buyer of their relative demerits, as well as merits, especially under the particular conditions involved in the use which his client intends to make of them, and to give him impartial assistance in making selections. Manifestly it is the duty of the independent engineer to expose all frauds, fallacies and spurious claims.

If there were but one form of light-source to be obtained there would be no occasion for the consulting illuminating engineer; the engineers of the manufacturers would be sufficient. But there are many different kinds of light-sources, and still more kinds of accessories, and these are rapidly and constantly multiplying; hence the growing necessity for the services of the consulting illuminating engineer.

The producers of luminants—the central stations and gas companies—are interested in furnishing their commodities to the public, and since they are working under public franchise it is particularly to their interests to have their customers satisfied. It is therefore a matter of self-interest for them to employ independent or consulting illuminating engineers to see that their patrons are not imposed upon by the overzealous—if not worse—"engineers," whose services are so freely offered.

Our contemporary says: "Finally, the brains, energy and money required to launch this new profession and establish

it firmly as a *bona fide* branch of science are supplied by the very men whom the writer derides and warns the public to beware of." Perish the thought! The men Mr. Macbeth "derides and warns the public to beware of" are the camp-followers and looters, and not the soldiers and officers who have been pushing forward with such vigor and honesty of purpose into this unexplored country.

"But," says our contemporary, "despite a sour and selfish attitude on the part of the writer, the article will do good; it will arouse interest and breed dissatisfaction with old and wasteful lighting methods." Aye, it will that! and it will also open the eyes of the consumer so that he can more clearly see through the wiles of the unethical illuminating engineer.

## The Illuminating Engineer as an Architectural Critic

It seems that the pot has been calling the kettle black; and Mr. Bassett Jones, Jr., comes valiantly to the defence of the kettle. In other words, illuminating engineers have been pointing out some of the atrocities in illumination for which the architect is responsible, and the architects in return are scoring illuminating engineers for criticizing matters upon which they must be, in the nature of things, grossly ignorant: What does an engineer know about the æsthetics of architecture?

A number of references in Mr. Jones' article, which appeared in the "illuminating engineering number" of the *Electrical Review,* have a wonderfully familiar sound. Some of them were opinions which we have expressed in the Proceedings of the Illuminating Engineering Society; others in the reading columns of this magazine, and still others in its advertising pages. We take this occasion to thank Mr. Jones for the ingenuous compliment of considering our advertising pages as technical literature. While architectural criticism is not strictly within the professional prerogatives of the illuminating engineer, there appears to us no reason, as we have stated before, why the universal right of having opinions on any subject within the scope of human knowledge should be denied to an individual simply because he has given special attention to some particular branch of knowledge. Furthermore, a knowledge of the general principles of æsthetics as applied to architecture is a highly desirable qualification in an illuminating engineer. The awkward part of the whole matter is that there are some architects of good standing in their own profession who are in entire agreement with the various criticisms and opinions which we have ventured to express heretofore. In evidence whereof, we reprint in another section of this issue an article by Mr. K. MacDonald, Jr., which appeared in a recent number of the *Architect and Engineer* (San Francisco).

## A Glass that is Opaque to Ultra-Violet Rays

In one of the earlier issues of THE ILLUMINATING ENGINEER we called attention to the importance of considering the invisible radiations from light-sources, and the probability that in the near future a shade or globe would need to be something more than a mere diffuser or a distributor of light rays. A number of the newer electric lights are very rich in ultra-violet rays, and the effect of their protracted action upon the organs of vision is a matter of the greatest importance, and one which has been receiving careful attention at the hands of oculists and physiologists. Some German oculists have recently reported a number of cases of cataract which have been ascribed to the ultra-violet rays of artificial light.

The discovery of a glass which, though transparent to luminous rays, is practically impervious to ultraviolet rays is therefore extremely interesting and opportune. A glass having these properties has recently been made by Drs. Schanz and Stockhausen of Dresden, Germany.

While the question as to the injurious effects of ultra-violet light is still, in a measure, unsettled, there is no doubt as to their being at least useless, so far as vision goes, and the eye is too precious to take any chances with. If the ultra-violet rays can be practically extinguished by the simple expedient of putting a transparent glass over the light-source, it is scarcely less than foolhardy to subject the eyes to rays that may work irreparable injury.

# Correspondence

## From Our London Correspondent

This is the month when everyone is thinking about having "New Lamps for Old," and so we shall devote this letter to a short description of lamps and burners fully illustrated.

It is not easy to ensure a good photograph of premises illuminated by gas light, but through the courtesy of Mr. W. F. Goodenough, Chief Inspector of the Gas Light and Coke Company, we reproduce an interior and exterior view of a large grocery and provision store, a type of business premises that is to be found in all parts of London and most provincial towns. These photographs were taken by gas light, and are fine examples of the brilliancy of incandescent gas lighting. The interior is lit, as will be seen, by means of what are known here as "gas arc lamps." As a matter of fact they are clustered upright incandescent burners, giving a very high duty per cubic foot of gas consumed. Every detail in the shop is brought out sharply; the lamps give a very steady and constant illumination, both gas and air supply being carefully adjusted and governed. The outside lamps are somewhat different in form, being of a self-intensifying type now exceedingly popular. Very great care is taken in the construction of these lamps in order that they may be practically draught proof.

New forms of lamps are very numerous this season. In Fig. 1 will be seen an arrangement for fixing an inverted gas burner upon an old-fashioned flat flame fitting inside an ordinary lantern. The burner is fitted with adjustable gas injector nipple.

The illustrations (Figs. 5 and 12) show a quite new burner, the "Tweedie," in two


STORE ILLUMINATION WITH GAS ARCS.

EXTERIOR STORE ILLUMINATION WITH SELF-INTENSIFYING LAMPS.

forms, the smaller being for ordinary lighting and the larger for factories and shops. The burners are very ornamental in appearance and give a most effective illumination. They are arranged to take standard globes and mantles. The main point in their construction is that the air supply to the bunsen is heated in an enclosed chamber, thus setting up a regenerative principle and a light of great brilliancy is assured. With a consumption of from 3 to 3½ cubic feet of gas an illumination of 90 candles is obtained without reflectors, but this can be increased by using suitable reflectors to 110 or even 120 candles.

The supporting of mantles for incandescent burners occupies the constant care and attention of inventors. Mr. M. Kriegel, in his latest patent (see Fig. 8), uses ordinary metallic wire gauze, as shown, in the form of a cup shape support, the crutch being received in the center. This gauze cup serves another purpose, in the shaping of the main body of the flame, and incandescence is obtained upon the mantle at a lower point than usual.

The illustration (Fig. 4) shows a popular form of high-power inverted lamp, which is sold at a remarkably low price. The lamp, including burner, mantle, inner chimney and opal globe, is sold at $9.36

FIG. 7.

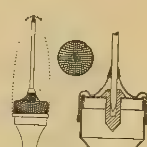


FIG. 8.

FIG. 1.

FIG. 2.

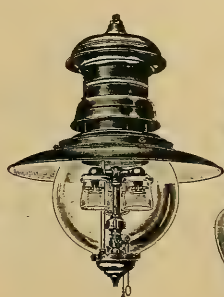


FIG. 3.

FIG. 4.

FIG. 5

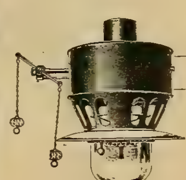


FIG. 6.

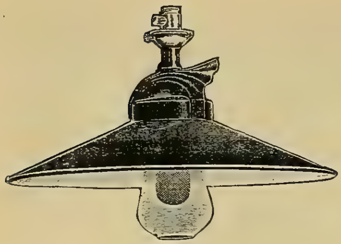


FIG. 9.

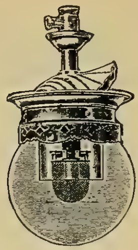


FIG. 10.

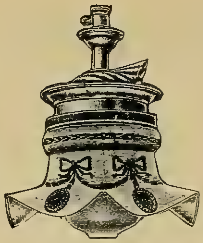


FIG. 11.

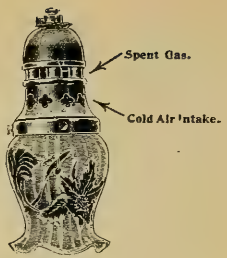



FIG. 12.

per dozen. This is about the cheapest gas lamp offered this season.

The sale of cutblooms and flowering plants has greatly increased, so that it has been necessary to devise some special means of lighting florists' shops in order that the products of combustion and foul air might be carried away. The manufacturers of the popular "Silva" lamps, Messrs. J. & W. B. Smith, have devised a special lamp (Fig. 6), in which clustered inverted burners are arranged, the lamp being fitted with a ventilating hood and flue so that the products can be carried outside the shop. The construction is simple and there is no doubt that the lamp will be extensively adopted by the florists.

The "Bland" inverted burner loses none of its popularity. Fig. 10 illustrates a self-intensifying burner which deelops 110 candlepower; Fig. 11, known as the "Household," shows a type that is much in evidence. They are exceedingly dainty in form, and the firm put forward a very chaste assortment of glassware for this particular burner. The "Bland" burners have also been specially designed for utilitarian purposes. In Fig. 9 we show a burner made with either an 8 or 12-inch enameled iron reflector. This is turned out as one fixture, the mantle and either clear or frosted glass heat-resisting globe being added. These are practically the three principal types, though the burner has been most efficiently adapted to street lighting.

A burner of a different form is shown in Fig. 13. In its construction there is triple combination of gas tap regulator, and bye-pass. Fig. 15 is an illustration of the "Etna" burner which has some strong points, notably in connection with the air supply and regulating shutter. Needle regulators are fre-

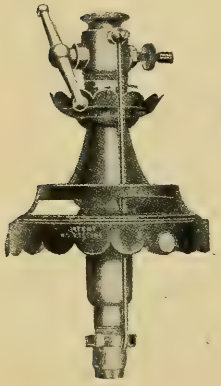


FIG. 13.

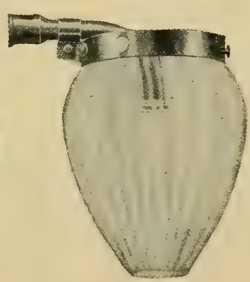


FIG. 14.

FIG. 15.

FIG. 16.

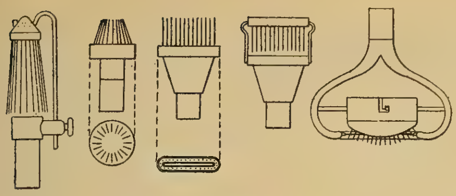


FIG. 17.

quently utilized, and Fig. 7 shows the one used on the "Etna" burners. It renders the supply of gas noiseless, and it is claimed that its use ensures the complete mixing of gas and air far better than the single-hole regulator.

It is the custom on this side to give an initial letter to a particular article, instead of a name. We have, for instance, K boots, and Fig. 14 shows us a K burner of the inverted type. This burner gives a light of 80 candles with a consumption of 3¼ cubic feet of gas. It is sold, complete with mantle, for 66 cents.

Figs. 2 and 3 are, respectively, lamps with clustered inverted burners for indoor and outdoor lighting. It will be noticed that in the last named lamp the mantles are pendant from an upright standard or pillar in the center of the base of the lamp.

There are many patents now being taken out having reference to filaments for illuminating purposes. In Fig. 17 we give five examples. These are used in connection with the "Buisson-Hella" light, referred to in the October, 1908, issue of this magazine. We will not attempt to describe the methods of manufacture. They are complex and of little interest to any but those engaged in the mantle business. Taking the illustrations from left to right we have a conical suspended mantle, a conical mantle fixed at its base, a flat mantle fixed at the base, a suspended flat mantle and a circular mantle for an inverted burner. Only the first named, so far as we know, has passed the experimental stage, and even that does not appear to have a very brilliant future before it.

We will conclude this article by a short reference to a new form or style of fitting for gas lighting. Fig. 18 is an exceedingly beautiful example of the metal workers' art. The square panels, above the fringed silk shade, are finished in copper or silver rapaisse, all the metal work counterbalance being in the same style. This particular design can be adapted for either electricity or gas. Fig. 16 is a handsome bracket designed for "Metrolite" burners, and Fig. 19 is a pendant carrying the same burners. These are all manufactured by Messrs. Evered & Co.,

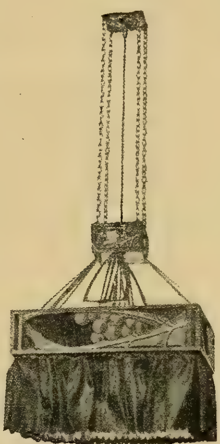


FIG. 18.

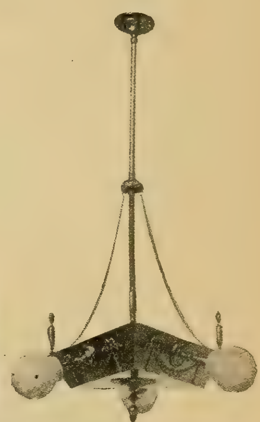


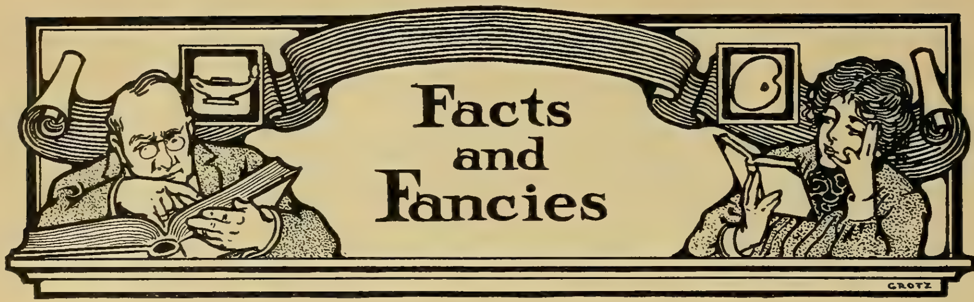
FIG. 19.

who have extensive manufacturing premises within a few hundred yards of "Old Drury," one of the oldest theaters in London.

CHARLES W. HASTINGS.

LONDON.

Note—The writer would gladly give further particulars of the burners describe if readers will make known their wishes to the Editor of THE ILLUMINATING ENGINEER.




# How J. Peter Packard Learned to Light Up

By Guido D. Janes.

J. Peter Packard of the clothing manufacturing firm of Packard & Company, Ducktown, was quite close fisted, and he did not burn the candle at both ends for illumination.

On the entire seventh floor of the Reyalite Building, the firm carried on its vocation, and warranted all the buttonholes, pockets, etc. But the workmen were generally quite sad and morose, for after their day's labor was concluded they would have to grope their way home.

WHY DO YOU ACT LIKE A LIFE MEMBER OF A BLIND ASYLUM?

"Why do you act like a life member of a blind asylum?" asked the wife of August Brenizer (August worked in Packard's institution). "Illumination at the factory is so pre-historic that we have to feel our way around when we wish to stroll over the place. No outside light comes into the window because the altitude of other buildings kick the said light on the shins and make it stay away. Our kerosene lamps hung up around the place are worse than scabs when carrying on their duties."

"Why don't you tell the foreman that you are not residing in the dark ages but in the illuminated ones."

"Won't do no good." Then August took out his handkerchief from a pocket and imprisoned a tear in same.

"Well," remarked Mrs. Brenizer with several vertical wrinkles on her face, "I'll go down and see the foreman, and tell him he belongs to another locality."

"Where?"

"Plutonian shore."

But Mrs. Brenizer did not go for something took place the next A. M. It was a foggy morning, the lamps were bilious and out of sorts. But the manual labor in the factory did not mind this. They labored right along as though a tungsten light were very contiguous to them.

The foreman saw them shunning the loaf vocation, and was quite elated, but upon examining their output he made the discovery that the wearing apparel had buttons on the bias while the hip pockets were sewed in the coat.

With at least three tears in the left eye and not over four in the other, the foreman journeyed to the office of Mr. Packard and interrupted him with a sob.

"Poor illumination is reflecting itself in our output," remarked the foreman.

"How come?"

"Our day labor cannot see to marry a button to a buttonhole while the pockets in the garments are dislocated. The illumination in the factory is so dark, it makes them afraid of the dark and they can't work."

Packard agitated his head with his finger, thought a couple of minutes then began to look on the pleasant side of life.

"Go down to Smith's and buy a hundred miner's lamps. Have them sent up and give one to each man to wear. That will solve the dark question."

"All right." And the foreman strolled out of the office, after which he went down to Smith's and purchased the said miners' lamps. Then after they were delivered he distributed same among the labor and told them to be happy and do a better quality of work.

"Very well," they said.

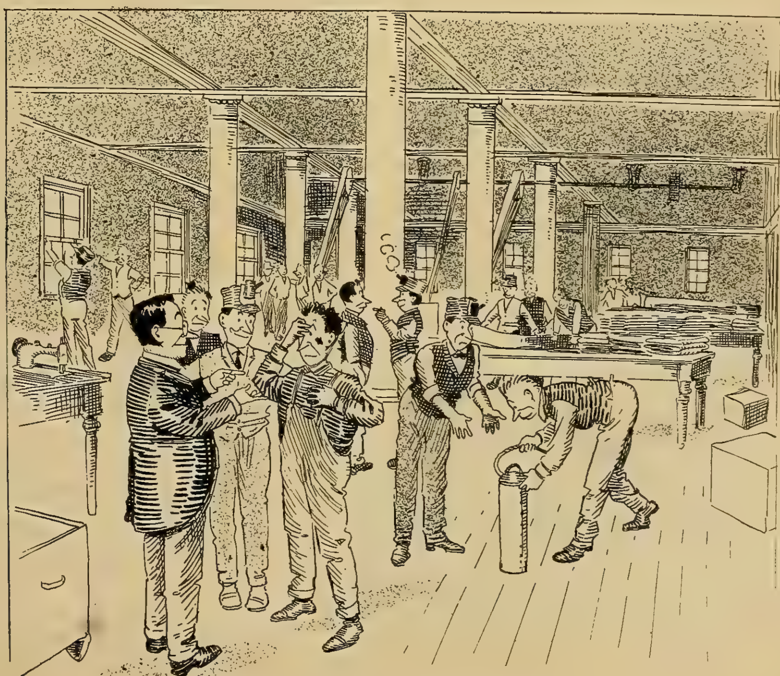
For a time the scheme worked all right. Each man could see better and always was in the presence of illumination. The grade of work grew better, and the buttons sought their proper locations. The foreman was so well pleased, he quit beating his wife, and Packard bought a four cylinder car and put an "Ad" in the paper for chauffeur.

But one day while Packard was looking

HE DISTRIBUTED SAME AMONG THE LABOR.

over the ledger some one came into his office and yelled "Fire!" "Conflagration!" "Goodness!" several times.

Without pausing Packard strolled out



I CAME NEAR GIVING SOME ADJUSTERS A JOB.

of his apartment and journeyed into the factory and saw something that was not pleasant. In fact it was so unpleasant you could smell and see it. But by the time he reached the far end of the place the unpleasantness had been extinguished with a Babcock fire put outer.

"What's the difficulty?" inquired Packard, endeavoring to get the smoke out of his eyes.

"No difficulty but foolishness," remarked Brenizer. "I came near giving some adjusters a job by leaning over too far. Yes, I leaned over so far that my lamp kissed some goods. That started the foolishness, then the conflagration spread to me. I am now going to sue you."

"How much?"

"$2,000."

"Please don't. I'll tell you what I'll do. I'll put in enough illumination to make ordinary daylight resemble twilight if you don't drag me into court. I'll give you a permanent job, too."

"What kind of lights will you put in?" asked Brenizer between pains the burns had made.

"Welsbachs, tungstens, flaming arcs, ice water and electric fans."

"All right, I'll feed the damage suit to the statute of limitations."

"Hurrah!" shouted the rest of the workmen, "we can now see our way through life clearly. No more after supper darkness for us."

"Hurrah for Packard! Hurrah for Brenizer!"

"Thanks," remarked Packard and Brenizer.

"You're welcome."

# Diagnosis Under Artificial Light

By F. W. L. Peebles.

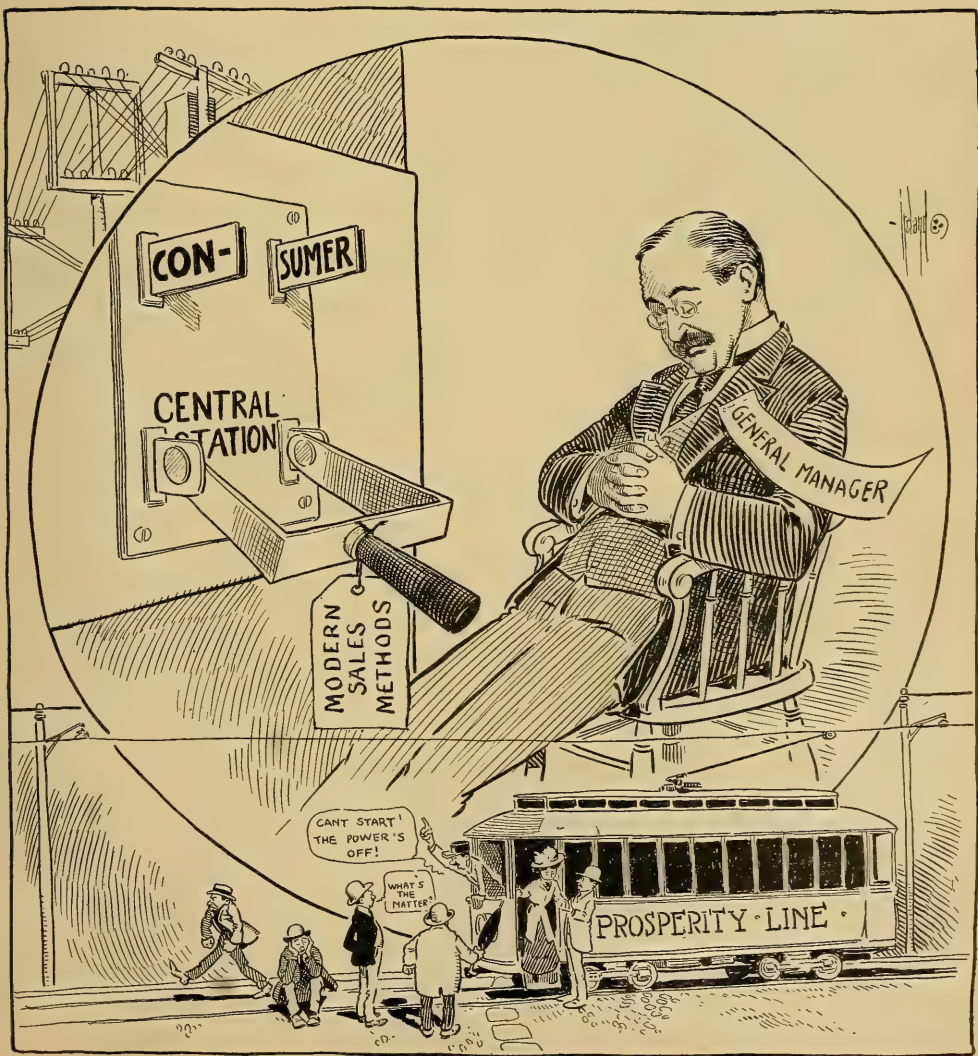
In the discussion of "Diagnosis under Artificial Light," in the September issue of The Illuminating Engineer, Mr. Morrison states that "the eye accurately reports the excess of red color, * * *"; also, "under city gas light, appear much redder than it really is" (i. e., the tissue).

To my mind this is quite misleading. Under red light the tissue will not appear *redder*, but it will appear *whiter* than it really is, because red will have maximum illumination and even white can be no brighter, while the blue end of the spectrum will appear the darker for the abnormal lighting. Probably an example will make the point more evident: Any one who has worked in a photographic dark room and has cut his finger will know that it is impossible to distinguish between blood and water. In my first experience I suspected that I had cut my hand, but on examination I could see only what seemed to be water; further examination, however, in daylight revealed blood stains on the finished work. The same fact is usually overlooked by the dry plate makers, who frequently print cautions in red ink to make them more noticeable, when in reality this color is quite invisible in the dark room.

I have had no little experience with the diagnostic end of illumination. Color values are badly distorted, but as the major part of the work deals with red a very valuable corrective may be found in the mixture of some green light with the ordinary artificial light. Two ordinary 16-C. P. lamps, "painted green," to one 16 C. P. clear lamp will yield a light that will report red gradation fairly truly, and while the whole aspect will appear darker than with true white light, and while the greens and blues will be much distorted, this fact is not material in diagnosis.

CASHIER BOOKKEEPER CONTRACTS ADVERTISING

# Commercial Engineering of Illumination




"ASLEEP AT THE SWITCH"—AN OLD-TIME CAUSE OF MANY WRECKS.

# Elements of Rate Making

By A. M. Tinsley.

Two distinct items have to be considered in calculating the Central Stations cost to serve; first, the fixed charge per kilowatt capacity, or the ready to serve charge, and second, the operating expense or the cost per kilowatt hour. Hence the value of the service rendered to any consumer, must, as far as practicable, be based upon the cost to serve this individual consumer and not on the average cost to serve the entire body, and as the cost per kilowatt hour varies with different classes of service so should the charge per kilowatt hour vary in proportion.

One consumer may have 20-16 C. P. lamps, or 1-K.W., connected and burn these lamps ten hours per day, while another consumer may have 200-16 C. P. lamps, or 10 K.W., connected and burn same only one hour per day. The number of kilowatt hours per month for each consumer will be the same.

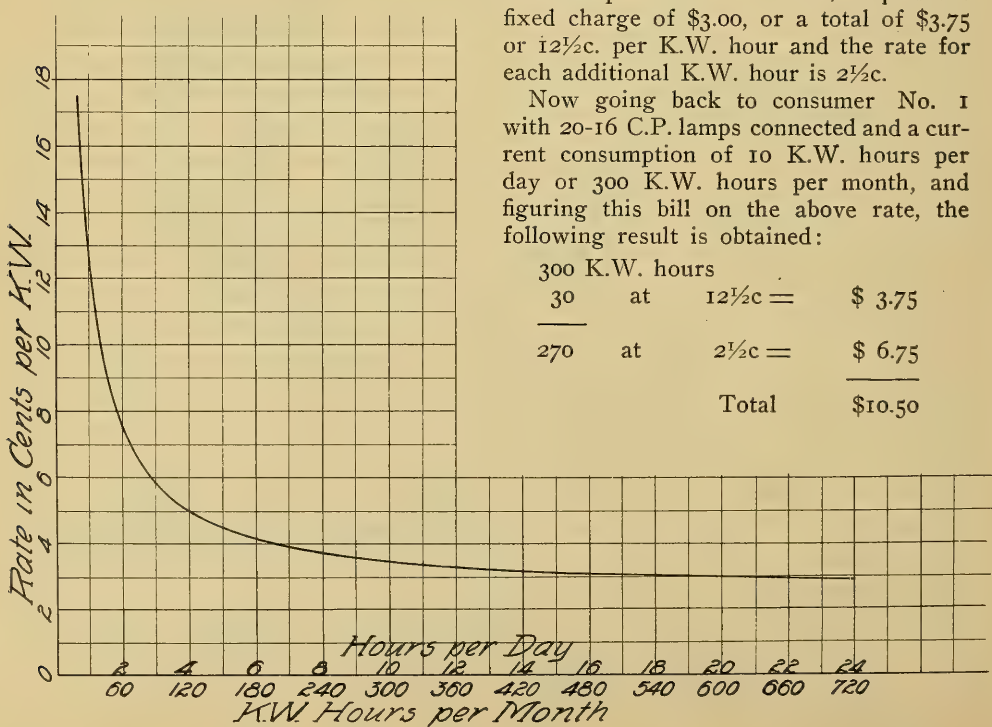
Assuming that both of these consumers use their service on the peak load, the capacity required to serve No. 1 will be only one-tenth that required to serve No. 2, therefore the fixed or ready to serve charge for No. 2 should be ten times that required of No. 1.

Take for example a central station having a maximum demand of 100 K.W., representing a total investment of $30,000.00, or an outlay of $300.00 per K.W. capacity. Figuring interest on investment at 6 per cent. and depreciation at 6 per cent., gives a total fixed charge of $3,600.00 per year, $36 per year or $3.00 per month per K.W. capacity.

The cost per kilowatt hour or operating expenses includes fuel, water, oil, waste, management, labor, rents, taxes and insurance. Assume that this amounts to 2½c. per K.W. hour. For the first 30 K.W. hours per month, per K.W. demand the rate per K.W. hour is 2½c. plus the fixed charge of $3.00, or a total of $3.75 or 12½c. per K.W. hour and the rate for each additional K.W. hour is 2½c.

Now going back to consumer No. 1 with 20-16 C.P. lamps connected and a current consumption of 10 K.W. hours per day or 300 K.W. hours per month, and figuring this bill on the above rate, the following result is obtained:

| 300 K.W. hours | | | |
|---|---|---|---|
| 30 | at | 12½c = | $ 3.75 |
| 270 | at | 2½c = | $ 6.75 |
| | | Total | $10.50 |




RATE SCALE.

while customer No. 2 with 200-16 C.P. lamps will have a bill figured as follows:

300 K.W. hrs at 12½c = $37.50

The accompanying rate scale, made on the above basis will show the actual cost per K.W. hour for the various number of hours' use per day.

The scale of rates varies according to the amount invested per K.W. capacity and the operating expenses. In some instances the fixed charge will amount to several times that given in the above scale, in which case the number of kilowatt hours used at the higher rate will be increased in proportion.

What per cent. of a customer's connected load will come on the peak can be approximately determined in each individual case.

It is fair to assume that not more than one-third of the connected H.P. in motors will be on the station at any one time, this is a general rule where the plant is furnishing service for a number of motors, no one of which is a large per cent. of the generator capacity. Assuming that only one-third of the connected H.P., in motors, will be on the peak it is fair to figure the fixed charge on this class of business at one-third the fixed charge per K.W. capacity of plant.

The rate for residence lighting can be determined from local conditions, according to hour of peak, etc. As all of this class of service is comparatively short hour business it is advisable to make one rate per kilowatt thour, and a low minimum charge.

By making the minimum monthly charge for all commercial lighting and power, equal to the cost of all current to be charged for at the highest rate, the above scale of rates can be made comparatively simple, as shown in the following contract form:

..................190...

To the ........ Co., .........

You are hereby ordered to connect your electric light and power service to building No. ............ (or at your option to any building designated in writing by the subscriber), of capacity to provide for 20-16 C.P. lamps—1 K.W., and in consideration of your so doing and the covenants hereinafter contained, we agree to take from you our entire requirements for light and power during the continuance of this contract.

This contract shall be in force from date hereof and for a period or periods of ........ year.. until either party shall at the expiration of any of said periods terminate same by written notice.

Accounts are payable at the Company's office on or before the succeeding 10th day of the month. In the event all accounts due from the subscriber hereto are not paid by the 15th inst., the supply of power may be cut off by the Company until said accounts are paid, without thereby releasing the undersigned from this contract.

We agree to pay you during the term of this contract $3.75 per month, to cover a maximum service of 20-16 C.P. lamps—1 K.W., which may be used not to exceed 30 K.W. hours; additional use to be paid for at the rate of 2½ cents per kilowatt hour, less discount of 5 per cent. if bill is paid on or before the tenth of the month. Should the service exceed 20-16 C.P. lamps—1 K.W., the above charge of $3.75 shall be proportionately increased.

The consumer agrees to deposit with the company a sum that the latter may deem sufficient to guarantee the payment of all bills rendered under this contract or any other indebtedness to the company.

Authorized agents of the Company shall have access to the premises at all reasonable times for the purpose of examining motors, meters and wires, or for the purpose of disconnecting the wires for nonpayment of bills when due, or for the removal of its property.

If at any time the ........ Company of ........ shall be compelled by any cause to discontinue in whole or in part, the operation of its lines, it shall not be liable for any failure to supply service, but in all cases shall use its best efforts to resume the operation of its lines.

The terms of this contract cannot be varied nor waived by any representations or promises of any canvasser or other person unless the same be in writing and signed by an officer of the Company.

Accepted for the ........ Co., of .......

Per .............

............

Consumer.

In cases where the consumer's use does not justify the guarantee of the fixed

charge, a higher rate per K.W. hour can be used with a lower minimum charge and the following contract form used:

.............., 190..

To the ........ Co., ........:

You are hereby ordered to connect your electric light and power service to building No. ............ (or at your option to any building designated in writing by the subscriber,) of capacity to provide for 20-16 C.P. lamps—1 K.W., and in consideration of your so doing and the covenants hereinafter contained we agree to take from you our entire requirements for light and power during the continuance of this contract.

This contract shall be in force from date hereof and for a period or period of ........year..until either party shall at the expiration of any of said periods terminate same by written notice.

Accounts are payable at the Company's office on or before the succeeding 10th day of the month. In the event all accounts due from the subscriber hereto are not paid by the 15th inst., the supply of power may be cut off by the Company until said accounts are paid, without thereby releasing the undersigned from this contract.

We agree to pay you monthly during the term of this contract a minimum charge of $1.40, in consideration of which we may maintain connection to your lines for apparatus having a capacity of one Kilowatt, and use 8 K.W. hours. Additional use up to 30 K.W. hours to be charged for at the rate of 12½ cents per K.W. hour.

Use in excess of above to be charged for at the rate of 2½ cents per K.W. hour.

Should the capacity of the apparatus connected exceed 1 kilowatts the above minimum charge and use permitted thereunder, also the additional K.W. hours use to be paid for at the rate of 12½ cents, shall be proportionately increased.

Bills are subject to a cash discount of 5 per cent. if paid before 10 days from date of bill.

The rates herein mentioned apply to lighting service only.

The consumer agrees to deposit with the Company a sum that the latter may deem sufficient to guarantee the payment of all bills rendered under this contract or any other indebtedness to the Company.

Authorized agents of the Company shall have access to the premises at all reasonable times for the purpose of examining motors, meters and wires, or for the purpose of disconnecting the wires for non-payment of bills when due, or for the removal of its property.

If at any time the ...... shall be compelled by any cause to discontinue in whole or in part, the operation of its lines it shall not be liable for any failure to supply service, but in all cases shall use its best efforts to resume the operation of its lines.

The terms of this contract cannot be varied nor waived by any representations or promises of any canvasser or other person unless the same be in writing and signed by an officer of the Company.

Accepted for the ............

Per ............

............,
Customer.

Should the company desire to give an additional discount to the larger consumers, the following special discount clause may be inserted in contract:

"On monthly bills of over $50.00 a special discount for each $10.00 value will be allowed, but in no case shall said discount exceed 25 per cent."

By inserting this clause in contract a consumer having a monthly bill of $50.00 would receive a special discount of 5 per cent., while a consumer having a bill of $250.00 or more would receive a special discount of 25 per cent."

All central stations doing a commercial lighting business have certain peak seasons, generally during the short winter days.

Should a consumer use service only during this peak season the amount invested to supply this consumer would be the same as that required to furnish the yearly customer and the fixed charge for the year would be the same in each case.

There are, in nearly every city, a number of consumers of both light and power who can conveniently cut off the service during the peak load and in this case the Company (Central Station) can easily afford to reduce the fixed charge at least 40 per cent., and this will be found a good method to straighten out the load curve.

In cases where the minimum charge is to be reduced on this account the following clause is embodied in contract:

In consideration of ........ (the consumer) using no service between the hours of .... and .... during the months of ...., ...., ...., ...., ...., ...., of each year, the Company agrees to make a rebate of $.... on each month's bills, Should ...... (the consumer) use service during above restricted hours, then all rebates shall cease and all rebates allowed under this clause shall become due and payable to the Company on demand.

This clause works to good advantage in cases of consumers operating ice and refrigerating machines, automobile charging stations, pumping plants, etc. All that is necessary to enforce this clause is a letter of warning at the beginning of the peak season and a few unexpected visits of the inspector.

# No License for "Ad" Writers

When Shakespeare sailed ships into Bohemia regardless of the fact that that country happened to be an inland province, the statement went unchallenged, the discrepancy being set down as "poet's license." Fiction writers have never been held to strict account for the misstatement of scientific phenomena, provided such errors do not interfere with the plausibility of the story. But "ad" writers, presumably at least, are neither poets nor novelists. Their writings are strictly of the didactic order, their purpose being to instruct and convince. The farther they can keep away from the impression of merely talking for effect, and the more they can convince their readers of their exact knowledge and sincerity, the more effective will their work be.

Some of the most admirable advertising of an educational nature that has been put out within recent years is that of the Union Carbide Company, which we understand has come from the pen of Mr. John E. Kennedy. In a reading article in a recent number of the *Acetylene Journal,* however, Mr. Kennedy makes a slip in regard to some simple scientific facts which is so out of keeping with the general character of his previous work that we take occasion to refer to it in order to point a moral in regard to advertising in general.

The title of the article referred to is "Breathing Lamp Black in the Country." The purpose of the article is to bring out the unwholesome effects of kerosene lamps and to show the advantages of acetylene lighting by comparison. To this end the writer thus starts out:

"When madame heats her curling tongs she lays them across the chimney top of a lighted kerosene lamp. After they have heated enough she is very careful to *wipe* the tongs on a piece of paper or cloth before using them.

"Why does she so wipe them?

"A glance at the paper or cloth afterward will *show* promptly enough.

"She wipes them because, in the brief moments the tongs lie over the lamp they become coated with soot—lamp-black.

"And don't imagine that the lamp quits making soot after she lifts the tongs off the chimney. * * *

"So the habit of breathing lamp-black at night is common enough in country homes, and few will deny that it is injurious."

Here is the bald statement that kerosene lamps continually give off soot all the time they are burning. The average user of the kerosene lamp may not be versed in the theory of combustion, but he is at least possessed of good, average intelligence and observational powers, and knows the very simple fact that a kerosene lamp, burning normally, gives off no smoke or soot. The slightest indication of smoking is the signal for either turning the light down or retrimming. A lamp chimney is far more than a mere transparent covering to protect the flame from draughts. Its shape, from top to bottom, has to be nicely adjusted in connection with the particular burner for which it is intended, to insure complete combustion of the oil, which means a steady, smokeless flame; and it requires but the slightest interference with burner or chimney to throw the whole apparatus out of balance and give rise to the production of smoke or soot. Placing a pair of curling tongs on

top of the chimney will often interfere with the draught sufficiently to cause smoke; hence the soot on the tongs. If the tongs be held slightly above the chimney they will be as clean after heating as before.

Scientifically, acetylene light and kerosene lamp light are essentially the same, differing only in color value. They both emanate from flames produced by the combustion of hydro-carbon; both require nice adjustments of the air supply in order to produce perfect combustion, i. e., combustion in which no carbon is given off unconsumed; for soot, smoke and lampblack are merely fine particles of carbon that escape unconsumed in the process of burning.

The acetylene flame owes its greater brightness and whiter light—its two points of superiority over the oil flame—to the fact that the gas, being richer in carbon, gives a flame in which the carbon particles are thicker or nearer together, and also, since there is more carbon to burn, a higher temperature is produced, and hence the heated carbon particles, which are the source of light, give a whiter light. The acetylene flame is whiter than the lamp flame for exactly the same reason that a tungsten lamp gives a whiter light than the carbon filament lamp.

If "Madame" (who, by the way, judging from the illustration of the article, must have married very young, and who appears to be much delighted over the kerosene lamp method of heating curling tongs) will try holding her tongs for a second in an acetylene flame she will get a deposit of soot with a quickness and completeness that will throw the kerosene lamp quite in the shade. This fact is simply due to the cooling of the flame by the iron tongs, causing the carbon particles to be deposited before being burned up.

Following up the subject Mr. Kennedy says:

"Moreover, the lamp-black is only one visible product of many other invisible and more serious ones given off by kerosene lamps when lighted."

"Among these injurious products is carbonic acid gas, which, if breathed pure, would kill in five minutes."

He then goes on with some figures as to the amount of oxygen used up and carbonic acid produced by oil lamps. He neglects to state that an acetylene flame likewise uses up oxygen and produces carbonic acid gas.

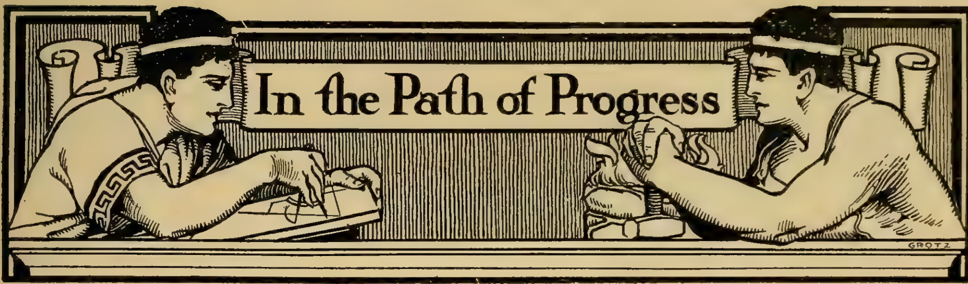
Now, acetylene lighting certainly has sufficient merit and superiority over kerosene oil lamps to give it a very long lead in the race for public favor without going out of the way to draw comparisons which have no foundation in fact. Unquestionably the light is of a more agreeable color, being practically of daylight whiteness, and is free from the annoyances (by no means small ones) necessarily accompanying the use of oil and glass chimneys. It produces somewhat less carbon dioxide for a given amount of light, but that is of no serious consequence; it also gives perceptibly less heat, which is a matter of considerable consequence in warm weather; and it is measurably less expensive. Furthermore, contrary to what is probably the general opinion, acetylene is far safer to use than kerosene or gasoline.

The misstatement of any fact in an advertisement naturally leads to a suspicion as to the truth of other statements, and so tends to discredit the whole advertising propaganda.

We call attention to this particular case not so much for the purpose of criticizing a particular "ad" as to point a general moral in the production of advertising literature. The poet is allowed his license, and the fiction writer is condoned for transgressing the laws of nature; but the "ad" writer has neither license or condonement, but must tell the truth, and nothing but the truth even though he do not tell the whole truth.

## Announcements

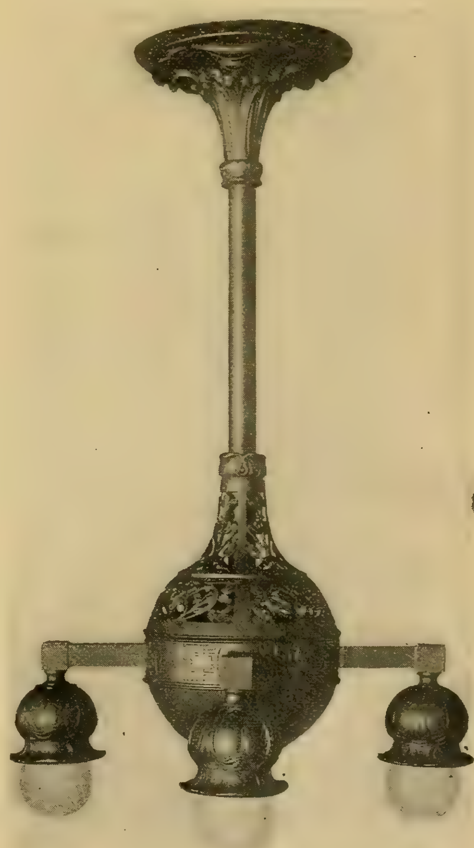
The Elmer P. Morris Company, designers and manufacturers of lamp posts, are now located in new offices in the West Street Building (90 West St.). A serious fire at their old quarters, 72 Trinity Place, necessitated the change, and taking advantage of the incident, they have moved into larger quarters at a location which is every bit as convenient and desirable.




## The New Westinghouse Nernst Lamp Fixtures

We have had occasion before to refer to the excellent artistic treatment given to Nernst lamp units, but the latest results in this direction far surpass all previous efforts. The new chandeliers are absolutely unique in the field of lighting devices. The Nernst lamp, as is generally known, consists of one or more glowers, which correspond to the filament in the incandescent lamp, a small resistance in series with each glower, which acts as an automatic voltage regulator, and an arrangement of a heating coil to start the glowers. All these parts were formerly housed in the casing of the lamp. This necessitated a comparatively large casing, which prevented the use of the lamps, at least without their appearing unwieldy, upon the arms of chandeliers. To overcome this difficulty manufacturers have hit upon the very ingenious and thoroughly practical scheme of placing these accessory parts within the fixture. In the case of chandeliers they are placed within a central body, as shown in the illustration. Such a body is entirely in keeping with the apparent structural necessities, and, in fact, is a form frequently found in an ordinary gas or electric chandelier. This central body is formed of a substantial cast metal ring about the center, which serves as a support for the arms. The upper part is made either of spun or cast metal of an ornamental form, which can be readily lifted to give access to the electrical parts within. The bottom portion of the body can also be removed by simply unscrewing an acorn at the bottom. This permits of the lamp being made practically as simple as the ordinary incandescent lamp, so that it can be put in place or removed by simply screwing in or out of the socket.

This construction permits of the widest range of lighting power that has ever been produced with a single chandelier, it being possible to use a total of 660 watts, which is equivalent to the largest arc lamps ever run for illuminating pur-



TYPE OF NEW WESTINGHOUSE NERNST FIXTURES.

poses. When the high efficiency of the Nernst lamp is considered, the size of this unit can be appreciated.

The Nernst Lamp Company is certainly to be congratulated not only upon the clever work of its engineers but also upon the thoroughly good art displayed by their designer. The illustration shows a fixture in Art Nouveau design, all parts except the suspension tube being of cast bronze. The contour is exceptionally graceful, and the decorative treatment a fine specimen of the Art Nouveau school. The chandelier is furnished with from two to six arms, and in a variety of decorative motifs, all excellent of their kind, and can be fitted with gas burners if desired. A line of brackets is being prepared which will involve the same devices, i. e., the mechanical parts of the lamp will be concealed in the wall plate, using the same simple lamp at the end of the bracket arm.

The Nernst lamp has been a far more powerful factor in establishing the science of illuminating engineering than is generally recognized. It has a natural distribution which lies almost entirely in the lower hemisphere, and gives its greatest intensity within 30 deg. from the vertical, a very desirable distribution from the illumination standpoint. When the lamp first came out in this country incandescent electric lamps were rated wholly on their horizontal candlepower, and the subject of distribution was little understood by the professional, and practically not at all by the layman. The Nernst lamp manufacturers therefore had to educate the public to an appreciation of the difference between mere candlepower, especially as rated in commercial lamps, and illuminating power; in other words, the difference between light and illumination, and this was the starting point and the foundation of illuminating engineering.

The recognition of the fact that the *science* of illuminating engineering, having become generally recognized, its treatment as an *art* must now be given greater attention, again places the Nernst Lamp Company in the vanguard in the progress of artificial lighting.

## A New Flashing Socket, the "Firefly"

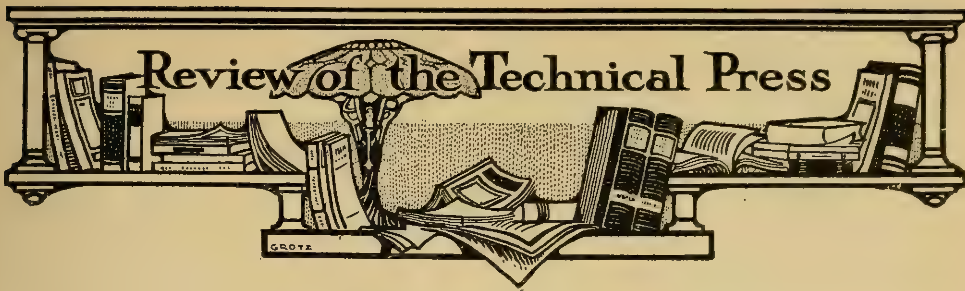
Realizing the desirability of a compact unit, containing both the flashing mechanism and a receptable for the lamp, C. O. Schneider & Co. of Chicago have now devised the "Firefly" flashing socket.

The flashing socket may be connected with the same facility as an ordinary socket, it being merely necessary to unscrew the insulating ring, to lift off the cover, insert the wires through the porcelain base, fasten them to the binding screws and replace the cover and ring. Then screw any lamp in the socket, even up to a 100 C. P. tungsten, turn on the current, and after waiting a minute until slightly warm, it will begin to flash the light on and off automatically from twenty to thirty times a minute for a year or two. No readjusting is necessary; it works equally well with direct or alternating current, and about one-quarter less current is consumed than if the lamp were burning constantly.

Thermostatic flashers are now very extensively used to operate lamps in small electric signs, for attractive window trimming effects, decorative lighting, Christmas tree lamps and as an excellent display stand for holding tungsten or other lamps to illustrate the light they give, by shutting it off and on. In some forms of small signs made of all glass and metal, the flashing socket can be used without the ring and cover.

## Euphos Glass

"Euphos" is a trade name given to a transparent glass, which is opaque to ultra-violet light. This glass is the discovery of Drs. Schanz and Stockhausen of Germany, and has created very wide and favorable comment in that country. It is now being imported in various forms, and offered to the trade by Franz Euler & Co. of New York.




# American Items

ILLUMINATION OF SEVENTH AVENUE, NEW YORK: *Electrical World,* December 7.

The article is illustrated with photographs and curves showing the distribution of illumination on the pavement. This avenue is exceptionally wide, with a strip of protected grass plot through the center. The illumination is by enclosed arc lamps, supported on posts of the "lyre" type placed in the central grass plot, and mast arm posts of ornamental design along the curb on either side.

ADVERTISING BY ELECTRICITY: *Electrical Record,* November.

Devoted to a description of some of the most characteristic electric signs used in New York, Chicago and Atlantic City.

LIGHTING OF A DENVER STREET: *Electrical World,* October 31.

A very brief description of the lighting on Sixteenth street, the "show street" of Denver.

THE LIGHTING OF A LARGE OUTDOOR ARENA: *Electrical World,* October 31.

Describes the lighting of the United States Military Tournament and Live Stock Show recently held in St. Joseph, Mo. The arena was 450 x 227 feet, and was illuminated by 127 six-ampere, multiple A C arc lamps, which were suspended on span wires stretched across the arena from poles outside the enclosure. The watts per square foot, assuming 62 per cent. power factor for the lamp, was 0.52. It is stated that the illumination compared favorably with that common in indoor lighting, and that it was possible to disinguish faces from one side of the arena to the other.

MEASUREMENT OF THE ILLUMINATION OF STREETS. By Dr. Louis Bell. *Electrical World,* October 24.

A letter to the editors written for the purpose of correcting a possible chance for misunderstanding in regard to Dr. Bell's statements in his presidential address to the Illuminating Engineering Society Convention.

### Art and Commercialism in Architecture

BY KENNETH MACDONALD, JR.

*The Architect and Engineer* (San Francisco)

Look backward for a few moments among the pages of architectural history to, we will say, the twelfth century, when the cathedral of Notre Dame was being constructed, and think of the sentiment and love of the beautiful which made its designers as well as each individual workman sharpen his pencil or chisel with the firm conviction that every effort toward making the edifice a thing of beauty would gain its reward in the afterworld. Think of the grotesques which were made to smile or to frown as the mood of the carver prompted. Each tried to surpass the other in his endeavor to do the best piece of work. Without the use of drawings in detail, and with a constant demand upon their ingenuity they labored and strove to accomplish a work of art. Such was the feeling which existed throughout the Latin races making the architecture of France, Italy and Spain what it is tcday, a precedent for all others to follow, when the opportunity arrives for them to do an artistic thing.

Let your thoughts recall the picturesque ruins of the Forum in Rome, where we can detect even among the shattered pieces, the great simple proportion and rugged honesty of those columns which were designed to carry weight by the true strength of the material of which they were made without depending upon a core of steel for stability.

What a sudden and disappointing revelation it is to bring the focus of one's eyes within the boundaries of our own commercially ridden country, where we are forced to imitate, always to imitate. Seldom or never is there a building constructed which does not imitate masonry by a false veneer of masonry forms, depending almost entirely upon a stronger space-giving skeleton of steel, which is necessary, to carry the lofty superstructure of a commercial building.

How often do we find a keystone which would not remain anchored to the frame within, even after the thrusts of the neighboring stones, as well as the stones themselves, have been taken away? Our universities, as well as the more advanced Ecole de Beaux Arts, laboriously trains us to imitate, never to build truthfully and sincerely of the material in hand.

A great many would say that this is on account of the fact that the skill of the engineer has surpassed the development of architecture. That the architecture is good in so far as it is satisfies the eye by virtue of what it is accustomed to.

It seems that if Americans had never seen the European works of art, had never been able to travel and to adopt the structural forms of a bygone age they would possibly have been compelled to create an entirely characteristic architecture of their own. That the skyscraper of today would look like a strong, bold demonstration of an engineering feat clothed in light delicate ornament, which would harmoniously reconcile art and force into a unit without disguise or artificiality.

The cornice of today owes its existence entirely to the fact that the human eye is so accustomed to it that it cannot be satisfied without it. It usually is anchored on to a fire wall which rises several feet above the roof and prevents its use as a drain for the roof water, for which the cymacium was orginally intended. The modillion, which archaeology tells us is the development of the ends of the roof timbers, extends only its visible length to the wall and is not infrequently made of copper or galvanized iron. Is it the fault of the layman that architecture has become so narrow or is it the fault of the architect, who could if he wanted to, by studied and gradual change lead and accustom the eye of the people to a truer and more sincere solution of the problems which they give him to do?

It seems that there will eventually be two distinct types of architects. The first will be the designer of the picturesque, where art reigns supreme, squeezing out in a large measure the thought of the investment. His class of work would naturally embrace ecclesiastical, monumental and domestic architecture. The second type would be the business man's architect, who could appreciate the merit of the investment, who could first of all design the building with a clear understanding of its renting value per square foot, proportioning its cost per cubic foot largely upon this basis—a man who could see the necessity of light and open the building to the sun. A man who could study a plan for an office building with the clear understanding that every square foot of corridor space saved would give a foot of rent-producing surface to his client.

This will eventually confine the commercial building to a study of texture rather than form, and in spite of its apparent limits will always give its designer the opportunity to use his taste in refined uses of color and form.

We have come to a period of commercialism and if we wish to do commercial architecture there is only one way to do it and that is to keep before our eyes the fact that the man who puts up a building as an investment wants the greatest possible revenue from it. That it is by no means the most elaborate building which commands the highest rent but the building which is designed with a good supply of light, and a good mechanical equipment. Such a building with a simple and tasteful facade will be a monument to its designer in the eyes of every business man who knows that it is a good investment.

# Foreign Items

Compiled by J. S. Dow.

### Photometry and Standards of Light

Dr. M. Corsepius, The Measurement of Mean Hemispherical C. P. with the Ulbricht Globe Photometer (*The Illuminating Engineer*, London, October).

A discussion of a new method of measuring M. Hem. Sph. C. P. with the Globe-photometer. This is accomplished by inserting a specially designed vessel so as to absorb at the light in one hemisphere, and prevent any of it reaching the sides of the globe. The author gives the results of some tests of arc lamps of various kinds

by the aid of the globe, and discusses the magnitude of the possible errors that may arise.

Drysdale, Dr. C. V., The Production and Measurement of Light (Continued), *The Illuminating Engineer,* London, October).

A description of various sensitive instruments used for the measurement of radiant energy.

Paulus, C., Vergleich der verschiedenen technischen Methoden zur Bestimmung der mittleren Horizontallichtstärke von Metallfadenlampen (*J. f. G.* October 3).

A discussion of different photometric methods of measuring the mean horizontal candlepower of metallic filament lamps, which has been commented upon in a previous review. It may also be of interest to mention an article appearing in the same journal entitled "Über die Photometrierung und die technische Lieferungsbedingungen von metallfadenlampen" (*J. f. G.* Oct. 3), in which a standard specification for use with the metallic filament lamps is discussed, and the exact method of photometric measurement to be adopted is considered in greater detail; this second discussion arises out of the previous paper by Dr. Paulus.

Patterson, C. C., and Rayner, E. H., Photometry at the National Physical Laboratory (*The Illuminating Engineer,* London, October).

A complete discussion of the photometrical arrangements and work carried out at the National Physical Laboratory at Teddington. Particulars are given of the arrangements of the benches, the photometers employed and the various errors that are likely to occur in standard work. Details are also given of the system on which life-tests are undertaken.

Trotter, A. P., Illumination: Its Distribution and Measurement (Continued) (*The Illuminating Engineer,* London, October).

A general review of some essential characteristics of photometers, followed by a description of some of the early work of Bouguer and the photometer connected with his name.

Waldram, P. J., The Measurement of Daylight Illumination and Sky Brightness, (*The Illuminating Engineer,* London, October).

Describes a modification of the Trotter photometer enabling a wide range of daylight illumination to be measured. The author describes some tests with the instrument that confirm the suggestion that the ratio of sky brightness to the illumination at a certain point within a given building is constant for a sky of uniform brightness.

Wild, L., An Improved Form of Flicker Photometer (*The Illuminating Engineer,* London, October).

Describes a new form of grease spot flicker photometer. The author arranges the field of view of the instrument so that both sides of the disc can be observed simultaneously; the observer therefore balances the flicker on the two sides just as in a contrast instrument.

New Photometers and a Calorimeter (*J. G. L.,* October 6).

Describes some recent types of photometrical apparatus recently exhibited at the Manchester Electrical Exhibition. These include a new street photometer, in which the illumination is varied in a rather ingenious way. A small glow lamp is let into a tube and illuminates the whitened interior of a compact globe. A uniform illumination is thus secured, and rays of light emerge from an aperture so as to strike the photometer disc. The size of this aperture, and thence the illumination, are controlled by adjustable screens.

Normalien für Bogenlampen, aufgestellt vom Verbande Deutscher Elektrotechniker (*Z. f. B.,* October 10).

A reprint of the rules of the German Institution of Electrical Engineers relating to the photometry of arc lamps.

### Illumination

Edridge Green, F. W., The Perception of Light and Color, (*The Illuminating Engineer,* London, October).

An account of some of the physiological facts underlying the perception of light and color and their effect upon practical problems in illumination.

Niemann and Du Bois, Zur Geschichte des Beleuchtungswesens (*J. f. G.,* October 17).

A continuation of the historical survey, by these writers, of the development of artificial illumination. The present installment carries the description up to the nineteenth century; an interesting account is given of the various types of candles

and oil lamps that were evolved and the difficulties that were encountered in their evolution.

DIE INTENSITÄT DES TAGESLICHTES (*Ann. der Elektrotechnik*, September, p. 369).

An interesting reference to the use of selenium screens for the purpose of making records of changes of illumination during the day. A copy is presented of the diagram obtained by an expedition to Algeria for the purpose of studying a total eclipse of the sun. It is suggested that this method might be applied to school rooms, etc.

THE ILLUMINATING ENGINEER (Editorial, *Elec. Review*, London, October 15).

Some remarks founded upon the relations between the architect and the illuminating engineer. The writer criticizes the attitude of the latter and professes to voice the current impression of the architectural profession in the United States; it is probable, however, that those on the spot would consider that the views expressed hardly present the true aspect of the situation.

THE NEED OF GOOD ILLUMINATION FROM THE MORAL STANDPOINT.

SOME EXAMPLES OF PRACTICAL WORK IN ILLUMINATING ENGINEERING.

SOME EFFECTS OF LIGHT, VISIBLE AND INVISIBLE (CONTINUED).

Three articles appearing in the London *Illuminating Engineer* for October.

The first named points out that good illumination not only conduces to good order in the streets and aids the work of the police, but also plays an important part in the child's development.

The second article describes some recent developments in illuminating engineering in the United States, and the third deals with some peculiar physiological effects of light of different colors.

## Electric Lighting

Bainville, A., NOUVEAUX FILAMENTS ELECTRIQUES (*L'Electricien*, October 10).

Bloch, L., UEBER NEUERE ELEKTRISCHE LICHTQUELLEN (*J. f. G.*, September 26).

A general and readable review of recent developments in electrical illumination. It is interesting to observe that this journal, which deals primarily with gas, is now coming to take an interest in electric lighting, and recent numbers contain quite a number of articles on electrical matters.

Blondel, A., LES PROGRÉS DE L'INCANDESCENCE ELECTRIQUE. PROGRÉS DES LAMPES À ARC ELECTRIQUE.

Two papers read at the International Congress at Marseilles, containing a complete and up-to-date summary of recent progress in both arc and incandescent electric lamps and the developments of the scientific theory underlying their construction.

Cateaux, J. L., AUTO-TRANSFORMERS FOR ELECTRIC LAMPS (*Elec. Review*, London).

Duschnitz, B., A METALLIC FILAMENT LAMP FOR HIGH VOLTAGE AND LOW CANDLEPOWER (*The Illuminating Engineer*, London, October).

Describes a new type of lamp, in which a small carbon filament is mounted permanently in series with a metallic tungsten filament. By this means a lamp that can be placed straight across a high P. D. is obtained; yet it is claimed that the consumption is only 1.54 watts per H. K. A further advantage lies in the fact that, owing to the high cold resistance of the carbon filament, a great rush of current, when the lamp is first switched on, does not take place, with the result that the life of such lamps is prolonged.

Duschnitz, B., METALLISCHE LEUCHTFADEN UND METALLFADENLAMPEN IN DER FABRIKATION UND IN DER PRAXIS (Elek. *Anz.*, October 15).

A continuation of the serial article by the author describing, in an exceptionally complete manner, a number of recent patents relating to glow lamp manufacture.

Headley, E. E., THE PRESENT POSITION OF ARC LAMPS AND ARC LIGHTING (*Elec. Rev.*, London, October 15).

Hopfelt, E. E., EINE NEUE KOHLENFADEN-QUECKSILBERLAMPE (*E. T. Z.*, October 8, 1908).

A paper recently read before the German Institution of Electrical Engineers, describing a new form of mercury-carbon glow lamp. In this lamp a carbon filament, run at an exceptionally high efficiency, is mounted in an atmosphere of mercury vapor. It is claimed the pressure of this vapor hinders the tendency of the filament to volatilize, with the result that it can be run at a high temperature. Such lamps are said to consume about 1.8 watts per candle, and to be capable of running direct off 200 volts.

Davy Arc Lamps (*Elec. Engineering*, October 1).

Fittings at the New Holborn Borough Council Office (*Elec. Engineering*, October 8).

Public Lighting by Incandescent Lamps (*Elec. Rev.*, London, October 9).

Die neuren Bogenlampen (Z. *f. B.*, September 20 and 30).

Neue Lichtpausapparat (*E. T.* Z., October 8, *Elek. Anz.*, October 4).

### Gas, Oil and Acetylene Lighting

Koffler, H., The Generation of Acetylene Gas from Compressed Carbide Briquettes (*The Illuminating Engineer*, London, October).

The author describes a new type of briquette for use in acetylene generators. The characteristic qualities claimed for these briquettes are that they are not hygroscopic, and that they are used in the generator in such a way as to avoid the "after gassing" that is a source of trouble in the case of generators using carbide of the ordinary variety.

Marshall, J. T., A New and Improved Method of Lighting Railway Carriages (*Blau Gas*), (*G. W.*, October 3).

An illustrated article describing the method of applying this new form of liquefied gas to railways. The author claims a high calorific value, the gas being utilized with incandescent mantles in the usual way.

A Lamp for Florists (*J. G. L.*, October 5).

Describes a form of incandescent lamp that is intended to avoid the production of fumes and the products of combustion which are undesirable in the case of a lamp intended for use among a collection of flowers and shrubs, etc.

Lampe für flussige Brennstoffe, etc. (Z. *f. B.*, October 10).

A series of descriptions of recent patent processes bearing upon the use of oil and other liquid combustibles in incandescent lamps.

Professor Lewes on the Incandescent Mantle (*J. G. L.*, October 20), (*G. W.*, October 17).

A lecture on the incandescent mantles was recently delivered by Professor Vivian Lewes to the employees of the Gas, Light and Coke Company, in London, upwards of 700 being present.

Professor Lewes briefly reviewed the theories that have been put forward to account for the behaviors of a mixture of cerium and therium, and confessed himself an adherent of the catalytic theory. One interesting point referred to was the high power of radiating heat possessed by cerium. On account of this property, when the percentage of cerium is increased more than about 1 per cent., the increased radiation of heat from the mantle causes reduced temperature and lowered efficiency.

Professor Lewes once attempted to apply cerium to heating purposes. He found, however, that the substance no longer showed the same effect in masses that characterized it in a state of fine division.

Night Views at the Franco-British Exhibition (*J. G. L.*, September 29).

The Chipperfield Self-Compressing Lamp (*J. G. L.*, September 29).

High Pressure Gas for Distribution (*G. W.*, October 17).

Zundung des Gasgluhlichtes in Eisenbahnwagen (*J. f. G.*, September 26).

Gegen die Gassteuer (*J. f. G.*, October 17).

A tax on gas has been proposed in Germany and the gas journals are naturally concerned thereat.

### Contractions Used

E. T. Z., *Elektrotechnische Zeitschrift.*

Elek. Anz., *Elektrotechnischer Anzeiger.*

G. W., *Gas World.*

J. G. L., *Journal of Gaslighting.*

J. f. G., *Journal fur Gasbeleuchtung und Wasserversorgung.*

Z. f. B., *Zeitschrift fur Beleuchtungswesen.*

# Miscellaneous News

ATLANTIC CITY, N. J.—So much of the new lighting system for Atlantic avenue as has been completed and placed in service is a success. There is no division of opinion about that.

The towering corner standards are graceful and pleasing to the eye, and the smaller intermediate columns which for some reason or other have not been taken advantage of as yet, except in City Hall block, will add to the general effect when the removal of unsightly poles and awnings give them a chance to make good.

Altogether the city is indebted to the Business League, which first proposed the new lighting plan, and to the City Beautiful Commission which helped to procure councilmanic sanction for the expenditure.

Provision for the early illumination of the incandescent light columns between intersections will meet with approval. The lights are really needed to dispel some of the gloom consequent upon the decision of many merchants to close their places and turn out their lights at 6 p. m.

HARTFORD, CONN.—The street commissioners recommended to the board of contract and supply that the bids on lighting the city, beginning June 1, 1909, which were received from the gas and electric light companies several weeks ago, be rejected and a new advertisement made along more specific lines. This recommendation was made after the services of an expert had been obtained on the lighting question.

President Austin C. Dunham and Manager Ralph W. Rollins of the Hartford Electric Light Company were at the meeting of the board, and asked that the time for opening the new bids on the lighting contract be extended to January 1, because of the inability of the electric light company to prepare estimates on the Magnetite lamps before that time. President Dunham agreed with the board that if the extension of time is granted, he will be willing to extend the electric light company's present contract with the city at least three months, to give the gas company an opportunity to install its new plant, in case the contract goes to the gas company.

BUFFALO, N. Y.—Mayor Adam, in a recent communication to the aldermen, touched upon the legal controversy between the city and the Buffalo Gas Company over the price to be paid by the city to the company for gas supplied, without contract, since July 1, 1907, up to date. The company demands 95 cents per thousand cubic feet of gas, but the city is willing to pay only 75 cents. When the company threatened to shut off the supply unless the bills were paid the city secured a court injunction, restraining it from doing so. That injunction is still in effect, but the court recently issued an ultimatum that the injunction would be vacated if the city did not pay up at the rate of 75 cents and let the remaining 20 cents per thousand feet go to the courts for decision as to whether it is a rightful charge. The city will appeal from that ultimatum.

In his walks and rides around the city the mayor has observed that in some places gas and electric lights on the streets are so close together that "one or the other was superfluous." The mayor frankly stated that the present cost of an electric light is $19 cheaper per year than it was in the fiscal year of 1906-7, but he added that, despite this reduction, the city's appropriation has increased from $306,909.05 to $317,100. He thinks that it is generally agreed that the city is better lighted than it ever was, and he predicted a time possibly when streets, where there are no gas mains, will be lighted with Welsbach oil lamps, which would cost more than gas but less than electricity. He then continued:

"If a gas supply cannot be had it may be that all Welsbachs will have to be changed to oil lamps. I would suggest that a thorough canvass of all lamps be made to find out if there could not be a more economical distribution."

The

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## *Contents of This Issue.*





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Entered as Second Class Matter January 13, 1907, at the Post Office at New York, N. Y.

# *The Spirit of Christmas*

*The spirit of Christmas is the spirit of light.*

*The most divine and noble characterization of Him whose birth it celebrates is contained in the expression, "He is the light of the world." His advent was heralded by a light in the heavens: "We have seen His star in the East, and have come to worship Him."*

*So naturally is light connected with the conception of Divinity that the Light of the World is invariably represented in art as actually radiating a luminous halo.*

*In all the festivities and customs incident to the celebration of this great event, light has ever been the most prominent feature.*

*The Christmas tree, radiant with candles, is a heritage of the Anglo-Saxon race from the Germans—that people of whom it may be said as of no other, "We are all children of a larger growth"—and is reminiscent of the time when candles were luxuries to such a degree that they were esteemed worthy as votive offerings. Old and world-worn beyond repair, or hopelessly small of soul is he whose heart is not quickened to sympathetic response by the spirit of the Christmas candle.*

*Our English ancestors obtained both warmth and light from the blazing logs in the fire-place, and bringing in the Yule log was the preliminary ceremony forecasting the light and joy of the glorious morrow.*

*Let us in this season of rejoicing stop to consider how much of the world is in darkness; how many of our fellow travellers to the grave are in the shadow of want, and poverty, and misfortune, and the unequal struggle in the battle of life. If we have light to shed let us shed it in the dark corners, not where there is already an abundance of sunshine.*

*We cannot hope to light the world, but if we can be "a lamp to the feet" of a single soul in his hour of darkness, we may "rejoice and be exceeding glad."*

*LET THERE BE MORE LIGHT.*

E. L. Elliott.

# Spectacular Lighting at the Dedication of the Hartford Bridge

For any public function or celebration to take place without spectacular lighting as a chief feature would be like acting "Hamlet," with Hamlet left out. Pyrotechnics have been known in China for thousands of years, but while their transitory brilliance is by no means to be despised, it has fallen to the lot of the twentieth century and the modern Proteus—electricity—to produce a permanency and grandeur of illuminating effects which are awe-inspiring in their impressiveness. The searchlight beam which swings through space like the finger of Destiny, and brings out in brilliant relief and glorifies the object at which it points; the endless tracery of glimmering lights outlining and emphasizing every line of architectural beauty and grandeur against the blackness of night, and the thoroughfares dazzling with a thousand counterfeit suns, together form a spectacle at which Apollo himself would have gazed in wonder.

THE CAPITOL, HARTFORD; A CAMEO IN A SETTING OF ONYX.

The special illuminations on particular events have also a far greater use than as a mere adjunct to the festivities of the occasion. They are a powerful object lesson, showing what can be accomplished by the use of light toward realizing the "City Beautiful." The first great spectacle of this nature that the world ever saw—the Chicago Exposition of 1893—demonstrated the possibilities and the advantages of decorative and spectacular public lighting and the fruit of the seed then sown is but just now beginning to ripen.

A thing of beauty is a joy forever—provided it be maintained forever. Why should we confine the delight which illumination so readily gives to a night or a week in the year, and be content to grope about in darkness or shadow for the rest of the time? Joys are surely not so lavishly bestowed that we can afford to dispense with any that are so easily obtained.

It is not enough that electric light enables us to burrow under rivers

THE CAPITOL TOWER BY SEARCHLIGHT.

Meadows trim with daisies pied,
Shallow brooks and rivers wide;
Towers and battlements it sees
Bosom'd high in tufted trees. —MILTON.

and streets, and to fill up the entire twenty-four hours of the day with labor; it should lengthen and beguile our hours of leisure and minister to our sense of the beautiful as well. Let us not allow this willing servant to become a task master; let us see that it lights the path of healthful creation, as well as the road of labor.

# Luminous Decorations

The possibilities of the electric light for producing beautiful, mysterious, and fascinating effects in decorative lighting have been but scantily utilized. These possibilities have been enormously increased by the introduction of the metallic filament lamp, which makes it possible to produce small glow lamps for decorative purposes that will run on very low voltages, so low as to be no more dangerous than the ordinary bell circuits, and capable of being supplied by batteries which can be secured at any supply store, or even department stores, and operated by the most untechnical novice. Of course, where commercial electric circuits are in use, it is more convenient to take the current from a regular lamp outlet.

The different forms which the miniature lamp bulb may take are simply unlimited. There is no kind of fruit or nut which may not be imitated, and the small, clear lamps may be readily concealed within the petals of flowers, the leaves of plants, or natural objects of any kind.

The development of decorations embodying these ideas is a commercial proposition by a New York firm and affords an interesting example of what may be accomplished by catering to a hitherto unfilled popular want. A firm who handled electrical supplies found themselves stocked up with a large quantity of decorative miniature lamps, for which there seemed to be little demand. Generally speaking, the buying public are not blessed with originality of ideas, and even the exceptions to this rule rarely have the time, or patience, or ability to realize their ideas. The firm in question therefore concluded that if the public were ever to be induced to take these decorative lamps off their hands, they would have to be shown how to use them. They then set about constructing a number of unique devices which could be taken home and set up as easily as an ordinary portable could be put in use. Seeing the things actually constructed, customers at once recognized the novelty and beauty of the devices, and made purchases. The supply of lamps on hand was used up in

FIG. 1—ILLUMINATED CHRISTMAS TREE.

FIG. 2—LUMINOUS AND NATURAL FRUITS.

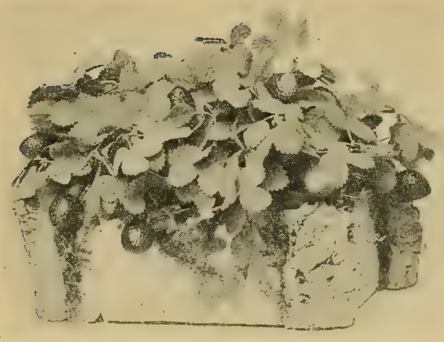


FIG. 3—GLOWING STRAWBERRIES.

FIG. 5—INCANDESCENT NUTS.

an unexpectedly short time, and the demand for the decorations grew apace. As a result, what was originally simply a scheme to dispose of some "dead" stock has become the leading branch of their business.

The illustrations show a number of the decorative schemes. Figure 1 is a tiny Christmas tree, on the branches of which are various fruits and nuts of different colors, each giving its own light.

Figure 2 is a table basket of fruit; the real product being placed in the lower basket, while the upper contains the luminous imitations.

Figure 3 shows a strawberry plant in full fruit; the strawberries forming the lamps. These luminous berries can also be placed about a real strawberry plant, if desired. Such plants can be obtained from the greenhouses at any season.

Fig. 4 is a spray of holly, or other leaves, to which may be attached berries, nuts, or fruits of any description, and the combination used for any decorative purpose desired.

Fig. 5 is another suggestion of a similar nature. The branch of the tree may be furnished with nuts or fruits, and is made more artistic by the presence of squirrels and birds.

All these devices are "self-contained," and may be put in place in a few minutes and connected for use to any electric outlet or to batteries.

FIG. 4—DECORATIVE POSSIBILITIES.

# Some Curios in Candledom

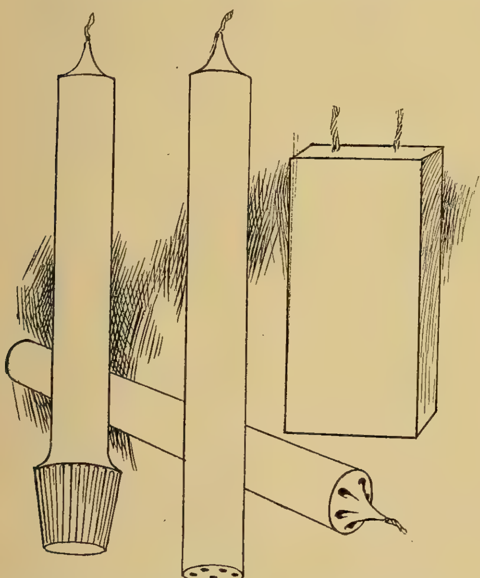
L. Lodian.

Hail! candlelight!—Without disparagement to sun or moon, the kindliest luminary of the three!

—Charles Lamb.

"There is hardly anything in nature more beautiful than a burning candle: the hollow basin partially filled with melted matter at the base of the wick, the creeping-up of the liquid; its vaporization; the structure of the flame; its shape, tapering to a point, while converging air-currents rush in to supply its needs. Its beauty, its brightness, its mobility, * * *; and its dissection by Davy * * * has rendered it more than ever a miracle of beauty to the enlightened mind."

—Tyndall.



PECULIAR FORMS OF CANDLES COMMON IN EUROPE, PRACTICALLY UNKNOWN IN AMERICA.

## The Perforated or Aerated Candle.

The perforated candle was first produced in Europe over half-a-century ago, and has been imported into and used in this country these thirty years. Why it has never occurred to an American candle factory to supply the local demand is one of those queries which must remain unanswered. Probably the greater part of our candle manufacturers would say they "never heard of it." Certain it is some foreign fabricants have for many years been quietly supplying the United States with this profitable line. It is the province of this magazine to make useful desirable wants in illumination known, so our own folks can "take the hint." Anybody is free to manufacture perforated candles,—all the patents, foreign and other, having lapsed "ages ago."

The molding is the same as with other candles, except that the tip on the piston has a corresponding number of shafts or prongs (three to five) to the channels or perforations to be made.

The perforated candle yields as nearly perfect a candle flame as is conceivable. Although one or all the perforations may be (apparently) covered with the melted wax or stearin in the little "well" as the candle burns, still the combustible, as it travels up the wick, is, in a sense, aerated through the ever-present and rising air in the central-draft perforations, and this naturally makes a purer light. It is sometimes, in fact, called the aerated candle.

Being hydraulic-pressed candles, they burn away slowly,—last longer, in fact, than one would think. Of course, the *raison d'etre* of the perforated candle, is to prevent "guttering"—as in carrying a naked candle upstairs; or, where this does occur, the "guttering" takes place inside the candle, i.e., enters the perforations—and is all duly used up in the burning candle, whereas all outside guttering is sheer waste. It is probably one of the most ingenious ideas in candle economics, and peculiarly creditable to the originating nation—the French.

Carrying a naked candle upstairs, and having it guttering, and some of the melted stearin dropping on to and instantly settling into your coat sleeve, is no pleasant experience, and you usually have a lively recollection of the effort required to subsequently get the grease and stain out.


EXTINGUISHING THE CANDLE AT BOTH ENDS.

### A Queer Use for a Candle.

In Marseille, southern France—the great home of the French candle industry—I have seen the perforated pure beeswax candle (as used in churches) made to do duty as a "straw" for imbibing iced drinks. It is shoved among the bits of ice in the glass containing the lemon squash, and the drinker coolly imbibes by aspirating through it. Of course there is absolutely no taste imparted by the wax candle.

### The Floating Soap-Candle of the Levant.

A writer in the journal *Light* some years ago, mentioned the soap-candle of Greece as if it was really the soap itself which was burning, and made to do duty as a candle. This was erroneous. No soap in the world, however rich its fat, oil or wax content, could be made to do duty as a candle, as the alkali-content (even if the soap was coaxed hard to burn) would liquify and surge up with the heat and drown any flame. What was meant was the flat floating-soap of the Greeks (who have manufactured floating soaps for hundreds of years, although known to us westerners but a few decades) which has a small "well" cut into the top with a knife, filled with sweet almond or olive or nut oil, and a wax match stuck through the center of the oil into the soap and ignited. It is a poor makeshift light, but "good enough" as a substitute when nothing else is available; and naturally the soap forms a non-upsetable base *par excellence*.

### The Candle Match of Southern Europe.

This is a far more convenient temporary light, and has been in vogue these thirty years or more. It is a sort of big wax vesta, put up in thin pasteboard affairs for pocket-portage, holding a couple of dozen, with eyelet hole at one end of the carton for receiving the lighted match candle. While the light may only last a couple of minutes, still it is usually ample for its well-understood temporary purpose,—as lighting one's way up a couple of flights of stairs, or negotiating a cellar or darkened room looking for something. When we try to do as much with a wooden match (which has to be inverted somewhat to burn) we usually scorch our fingers.

Quantities of these candle-matches are annually imported into Manhattan from Liguria; but why cannot our own manufacturers supply the market? Again (as before remarked) in all probability they do not know the demand exists—perhaps never heard of the candle match.


"IT FLOATS."

"THERE'S NO PLACE LIKE HOME."

## GIANT CANDLES.

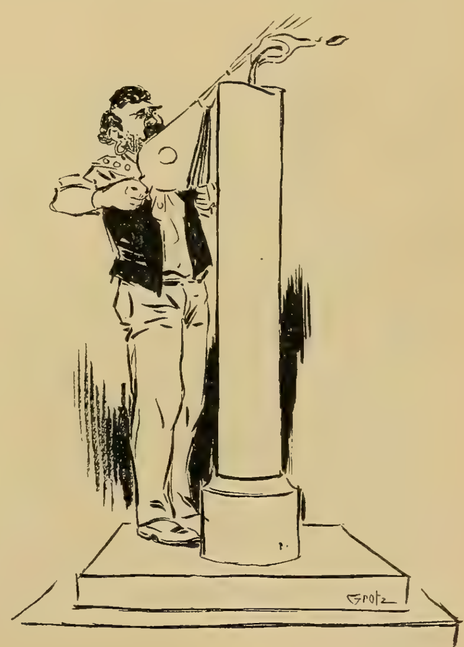
Then there are the giant candles of the Italian religious fairs. They are in use in every community of that race in America. Some of the candles are two meters (6½ feet) high, as thick as an adult's body, so they can be stood on their own base on the sidewalk. The wick is as thick as a bit of rope harness; but the flame is always smoky (wind or no wind); and they gutter so much, even in a perfect calm, that more fat is wasted than burnt. Some of these giants cost $25 to $30 apiece. They are supposed to be spermaceti candles, but are really almost anything. Still, they are cleanly to handle.

Possibly a quarter-million dollars is annually sent abroad to the Italian candle makers for these goods—candles ranging in value from $1 to $30 each. Why should not the supply be furnished by our own makers?

## HUMAN-FAT CANDLES.

This is an essentially Paris medical-students' idea. At some of their festive reunions in the Latin quarter you may see half-a-dozen U-shaped candles burning on the table; the candle is a dingy white, and the light is mediocre, since the fat has never been deprived of its glycerin. The students make them themselves, in view of a "celebration." The fat is obtained from cadavers in the dissecting room—preferably kidney fat. It is "tried out" in any vessel, strained, cooled somewhat, and poured into a glass lamp-chimney previously plugged up one end with a cork, through which a wick passes, and is kept taut in the middle, being secured at the center of the open end. Now it is placed in an icebox, so that the candle will contract, and after a couple of hours may be pulled out of the glass tube with shiny sides.

To curve into U-shape, it is placed in a warm place to slightly heat through gradually, and then bent over gently into the desired form. There is an object in this U shape. It is to carry out the old saying, "To burn the candle at both ends" (*bruler le bougie les deux fins*), for the candle you see is always burning at both



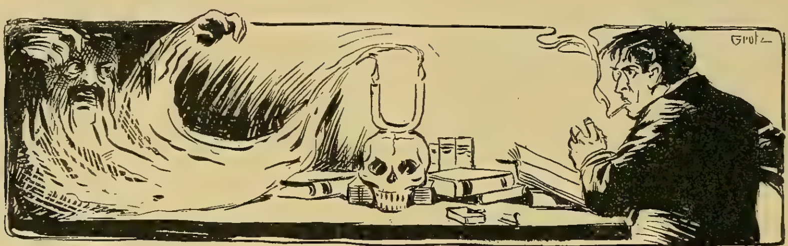
THE CANDLE: "WELL, I'LL BE BLOWED."

ends. It is done as a sort of defi to fate. For candlestick, a real skull (or part of one) does duty—the U-shaped candle is seen protruding up through the eye holes. The whole affair is truly, as the Gallics say, a "*chandelle macabre*."

Human-fat candles are not "lonely" in Paris; for some of the leading pharmacies stock a high-priced soap, known as human-fat toilet soap, costing 5 francs ($1) per small cake. It is perfectly pure, genuine soap, unscented, yellowish-white, and the fat is obtained from cadavers in the hospitals — usually from the submerged-tenth unclaimed class. It has been made for over a century to meet a limited demand, and Paris medicos have recommended it as a better emollient than ordinary soaps.

### Candles With Two Wicks.

These are square-shaped tallow "dips" used throughout France by the artizan classes. The wicks are about one-third of an inch apart. They are used in exposed or drafty positions, or for out-house or work-shop uses, so that if one light is extinguished it is easily relighted from the other.



"HOW ILL THIS TAPER BURNS."

# Better Light and Air for Miners

By A. Cressy Morrison.

For several years acetylene has been used in miners' lamps in France, Germany and Belgium to a large and steadily increasing extent, until at present it is used almost exclusively in over two hundred mines and by approximately fifty thousand men. The light is satisfactory, saves nearly 50 per cent. of the cost, giving more and better light. Mining engineers have been more or less familiar with this fact, but the introduction of acetylene into mines, up to the last two years, has been very slow in this country. Its use is now, however, coming to be recognized as an important advance, and it promises shortly to replace all other means of illumination, except in special cases.

It is seldom that an improvement in quality or advantage is accompanied by reduction in cost, but the paradox is a reality in the case of acetylene.

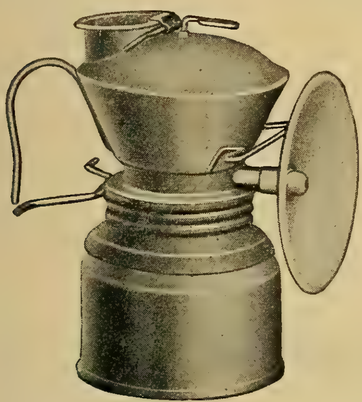
Candles, which are largely used throughout our western mines, remove seven times and kerosene five times as much oxygen as acetylene. The products of combustion given off by candles are ten times and from kerosene nine times as much as that given off by acetylene. The difference, therefore, is enormous. While acetylene in a mine gives off no smoke whatever, every miner is familiar with the difficulty from the products of combustion given off by other illuminants. Acetylene, therefore, makes for the life and comfort of the miners, protects them from the degenerating effects of insufficient oxygen and removes the one important cause of lung and throat troubles. The actual amount of illumination given by candles and kerosene is lessened by a very large percentage by the smoke and mist which so rapidly accumulate, whereas all the light given by acetylene reaches the point to be illuminated without any interference whatever.

It has been found, in actual experience,

that in entries which are sixty to seventy feet ahead of the air there is not the slightest particle of smoke from an acetylene lamp and the entry is just as clear at the end of a shift as it is at the beginning.

An interesting thing about acetylene is the tenacity of the flame. It is not easily blown out, the rapid motion of the miner will not cause it to flicker badly, and it burns brilliantly in an atmosphere so foul that candles fade and go out. In fact, acetylene will not deprive the miner of light until the atmosphere is so bad it will not support life.

For underground surveying and mine inspection the use of acetylene is or great



MINER'S ACETYLENE CAP LAMP.

importance. Maps and records escape the usual accompaniment of grease and smudge. The acetylene flame is so small and clear that it affords an accurate point on which to sight instruments.

Another use for acetylene in somewhat larger units is found where the rays are concentrated by a reflector, in which case a brilliant illumination can be thrown into inaccessible places where distant bays, high backs, caved places and other difficult and otherwise hidden parts of the mine can be explored with convenience, and, in case of emergency, without danger.

Acetylene is especially advantageous as a cap lamp for drivers, and it has been found, where mules are used that they can see much better and are not nearly so liable to stumble.

The very bad quality of oil for miners' use, which has in some states called for laws establishing a standard of quality (laws, by the way, which are frequently violated by a species of adulteration which almost defies defection) is becoming another powerful argument in favor of the substitution of some illuminant which can not be adulterated.

In this connection it is interesting to realize that acetylene is made in the miner's lamp as used, the principle being the bringing of water into contact with the carbide as the gas is burned and in just sufficient quantity. The difficulties of this problem have been effectively overcome. As soon as the pressure of gas reaches the proper point for burning, it holds the water in check until the consumption at the burner has so reduced the pressure that the water comes in contact with the carbide again.

In actual practice, it has been found that four ounces of calcium carbide at four cents per pound will give nearly ten candlepower clear illumination without smoke for five hours. One-half pound, or two cents' worth, will give the same illumination for ten hours. Candles in many parts of the country, counting four candles to the ten-hour day, would cost five cents per day. There seems, therefore, to be no reason why acetylene should not be introduced provided a proper lamp at an economical price can be devised. As a matter of fact, practical experience has demonstrated that some of the miners' lamps now upon the market meet all the necessary requirements both as to economy, lasting quality and practicability in use.

Acetylene miners' lamps are now frequently found in mines throughout the country, Pennsylvania, New Jersey and Illinois leading, though many other states are using the new light. The greatest number used by any one concern in its mines is probably by the New Jersey Zinc Company of New York, which has adopted acetylene illumination for all its mines. The number of miners' lamps in use in the mines of this company is about three thousand, and it has been found, in practical use, that the saving is at least two cents per day for every miner.

The whole method of using acetylene is as simple and the lamps now in practical use are so satisfactory that the subject of

better illumination in mines is worthy the attention of every mine owner and engineer. It is equally worthy the attention of every mining organization, as well as every individual miner, because a change to better illumination at half the cost, with greater output, safety, comfort, and above all, good health, are matters of such vital importance that no careful manager will fail to investigate the subject.

# Indirect Illumination

By Augustus D. Curtis.

Indirect illumination is acknowledged by all who make a study of artificial interior illumination as the most aesthetic and modern method. This form of illumination having the light source concealed and usually depending upon reflection from ceiling, walls or other reflecting sources for an even illumination of the room has been limited in its practical application, owing to the great loss or absorption of light after leaving its original source before it reaches the working plane.

Various attempts have been made to solve the problem and there are a considerable number of installations in which indirect illumination is applied in different ways, the most successful heretofore being that in which the light is hidden behind brackets or cornices around the edge of, and the light reflected toward the ceiling of the room. Another method which produces very pleasing effects is that in which the light is reflected through art glass in the ceilings of the room. Either of these methods produce very pleasing

FIG. I—LIVING ROOM ILLUMINATED WITH A 2 UNIT ELECTRIC FIXTURE.

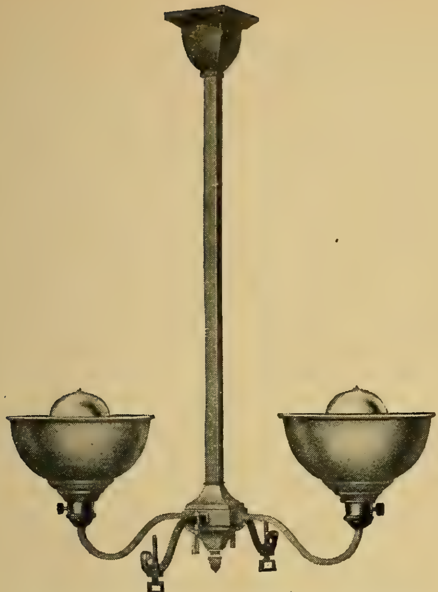


FIG. 2—TWO UNIT ELECTRIC FIXTURE.

results, and wherever expense is not to be considered these methods will undoubtedly grow more and more in favor.

Recent developments have made commercially available, that is, bring within the reach of the person of ordinary means, this method or system of indirect illumination. Valuable suggestions by members of the Illuminating Engineering Society were followed out, as also those by members of the Opthalmological Society, who are so emphatic in the assertion that most eye troubles are caused by the present method of artificial illumination in which the delicate mechanisms and nerves of the eye are subject to the direct rays of the intensely brilliant modern lighting units.

The successful solving of this problem and its practical working out depended upon two things:

FIRST: a light of high candle power at low cost.

SECOND: a reflecting surface that would give the first reflection of light upward without material loss. Where gas is used the necessary candle power and economy is found in using the higher grade incandescent mantle burners. Where electricity is used, the high efficiency of the Tungsten lamp proves an ideal source of light for this indirect lighting system. The intrinsic brilliancy of this lamp makes inadvisable its use in small rooms on ordinary chandeliers because of the blinding effect.

The design or shape of the reflector has an important bearing on the efficiency and on the effect produced in the room. The correct shape of reflector for throwing the rays of light to the ceiling without shadows, as adopted, has been the result

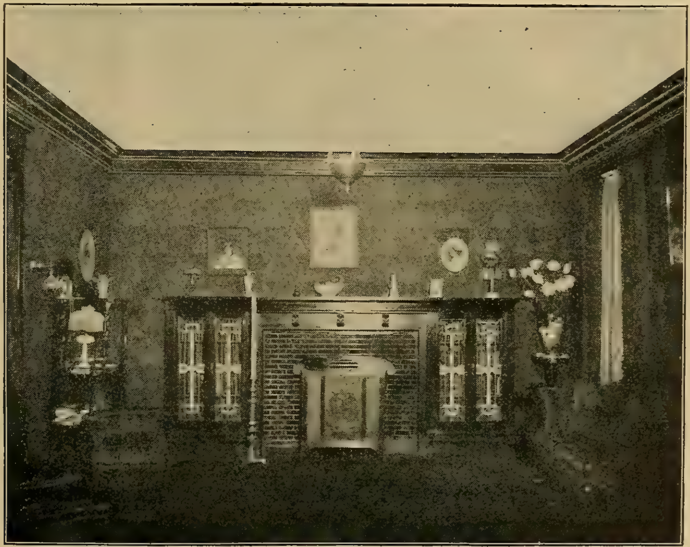


FIG. 3—PARLOR ILLUMINATED WITH A ONE UNIT ELECTRIC CHAIN FIXTURE CONTAINING ONE 60 WATT TUNGSTEN LAMP.

FIG 4—SINGLE UNIT CHAIN FIXTURE.

of considerable calculation and experiment. The perfected design is of a bell shape and contains peculiar circular and vertical corrugations. Being fire glazed, the exposed glass surface is easily cleaned with a soft cloth.

The indirect lighting units worked out consist of this scientifically correct bell-shaped corrugated reflector fitting in a spun brass casing. On gas fixtures this spun brass spinning rests on the base of the mantle like a globe. On electric fixtures this casing can either be suspended by chains or supported from below, as is the case of gas fixtures. It is evident that an infinite variety of ornamental designs can be worked out embodying these units. They can easily be installed on gas or electric chandeliers already in use. Unless the chandelier arms are very heavy, it can be applied on any electric chandelier where the sockets are pendent, as the arms do not cast annoying shadows on the ceiling, because the light comes from so many directions when passing the arms, due to the corrugations.

The lighting units should be at or near the centre of the room, though side lights can and have been used with satisfactory results. Light colored walls are not essential, as most of the light is directed to the ceiling.

Indirect illumination is not only more aesthetic, but enables one to see better. While it is true that there is a loss of light, another factor enters to overbalance this. The more easily details can be seen the more effective is the illumination. When there is a bright naked lamp in front of the eye, the pupils contract and therefore the eye takes in less of the light and the things that are illuminated are not seen as clearly as with less light with a wide-open pupil. Hence, the fact that there may be less light with indirect illumination does not mean that we see less clearly, but, on the contrary, we really see better. Many are of the opinion that we are suffering not from under illumination but from over illumination.

Of course, this system of illumination is not as practical with beamed ceilings or those of dark tint, but in the majority of instances we find the ceilings light and the conditions favorable. There are at present many experimental installations of this system in use among professional and business men in their residences and offices. Without exception, they are enthusiastic in its praise, and are so impressed with the eye-comfort derived by its use that they would go back to the old system of lighting only under protest.

These units can, of course, be arranged in a variety of ways. Only a few simple designs of fixtures embodying them are here shown. The fixtures can be installed in single units or multiples thereof, either electric, gas, or combinations of both, and it is practical to illuminate in this way, not only residences, but halls and auditoriums. A unit of one reflector and one 100-watt Tungsten lamp (about ½ watt per square foot), or a good gas mantle burner (consuming about 4½ cubic feet per hour) gives a beautiful illumination in a room up to 15 feet square. This consumption makes the cost very reasonable, being at the average cost of gas or electric current of from ½ to 1 cent per hour. This is probably not more than it costs in the majority of instances to illuminate such rooms now. The cost of installation and maintenance does not, we believe, exceed that of the ordinary methods now in vogue.

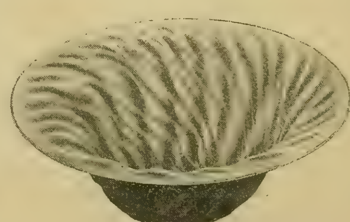


FIG. 5—TYPE OF REFLECTOR.

# Tungsten Street Fixtures

By C. O. Baker.

The exploitation of tungsten lamps, with an efficiency comparing favorably with that of arc lamps or even incandescent gas mantles, has opened up new possibilities in street lighting, and the engineers for the more prominent central station properties are studying to utilize *all* the light radiated from the incandescent filament in *every* direction and to distribute it evenly in some *useful* direction; and to space the fixtures for the effect of a minimum of contrast between light and shade over the area to be illuminated.

Formerly where dense foliage and low hanging boughs necessitated the placing of low units of candle power at frequent intervals and short distances above the street level, incandescent lamps were used without reference to their economy, in the fixtures with which we have all become familiar, and which with their 14-inch hoods and convex deflectors served

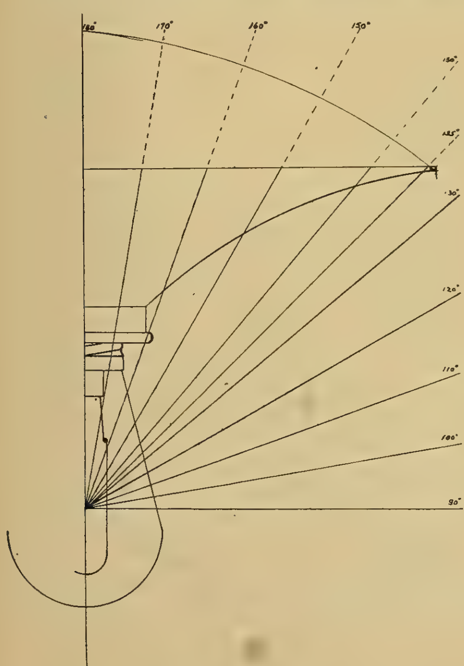



FIG. 1.

little else than as a housing for the sockets and a protection to the lamp against falling sleet and snow. The inefficiency of this fixture becomes patent on reference to the drawing below (Figure 1), which indicates the position of the convex reflecting surface with relation to the filament.

Placed so high above the filament, with its surface gradually receding upward toward its outer edge, it intercepts none of the light radiated below an angle of 135 degrees from the vertical, while the light that is intercepted is reflected so high above the horizontal as to be practically valueless for purposes of street illumination.

No form of reflector increases the total luminous flux, of course, and while mirrored glass or polished metal surfaces have a maximum of reflecting value, difficulties in mechanical construction, or deterioration on exposure, render them secondary in importance to white porcelain enameled steel for all outside purposes.

Since the area of illumination increases and the intensity decreases with the distance from the light source, the spacing and height of the fixtures will be governed by the foot candles required at the street level, and for a similar reason the reflecting surface will be suitably placed above the filament and of a form to concentrate or diffuse the light as occasion demands.

In street lighting the horizontally radiated light is the most useful, and the light radiated above the horizontal alone available for purposes of reflection.

Were it not for certain mechanical objections—which need not be detailed here—the ideal position of the reflector would be with its centre directly over and on a level with the top of the filament, and experience has demonstrated that a flat reflector placed on a level with the rim of the socket will effect the most

practical results. The subjoined polar candle power curve (Figure 2) shows by the dotted line the distribution around a bare 40 C.P. tungsten series lamp, and by the solid line the distribution with a reflector of the last mentioned type in the position suggested.

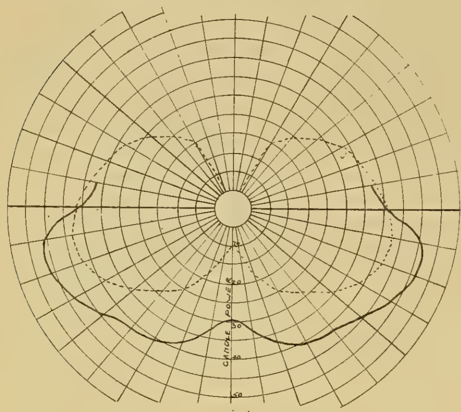


FIG. 2.

There are two street fixtures on the market, with white porcelain enameled steel reflectors, in which this principle is recognized; the one 22 inches in diameter, with undulating radial corrugations, and slightly concaved to provide a watershed, is attached directly to a cast holder deep enough to cover a porcelain series socket; the other, only 18 inches in diameter, fluted for even diffusion and flat, gives the wide light distribution shown in the curve above. The advantage of the lesser diameter, in the event of high winds, is obvious.

This latter reflector has a galvanized and painted hood edged in around it, whose smooth, rounded surface offers no lodgment for snow or sleet which would otherwise accumulate in unprotected corrugations. This hood also is attached to a cast holder deep enough to serve as a housing for the socket, with crossarms cast in one piece with it, and porcelain insulators held in place with washers and cotter pins.

Probably one of the greatest annoyances to which a station operator is subject is the malicious breakage of unprotected glass, and the guards hitherto furnished for incandescent street lamps have been unsightly basketlike contrivances fitting over the entire reflector and lamp. The second of the fixtures just described is provided with a guard just large enough to slip over the lamp and, conforming with the outline of the bulb, screws firmly into a threaded ring attached to the reflector. Whether by mechanical protection, or through moral effect (like a "Trespassers will be prosecuted" sign) in actual practice, with these guards in position the malicious breakage has been reduced to a trifling proportion of the lamps in service.

Manufacturers have designed reflectors to screen the light from the houses and throw it parallel with the street, nearly all of which have had defects overbalancing this advantage. This feature, however, has been very successfully worked out with prism glass, and while many will, no doubt, object that it is open to the misfortune liable to unprotected glass, spoken of above, installed under favorable conditions this reflector will undoubtedly prove of much service.

Various National, State and Civic expositions held since the general adoption of electricity as a medium for street lighting, have in a measure served to educate the public to the aesthetic possibilities of decorative lighting along boulevards, driveways and parks, while competition between gas and electric lighting companies, in their manoeuvering for strategic advantages, has developed methods of illuminating, distribution of lamps for effect, and accessories for producing all these to a point where even the most conservative of civic lighting boards is not unwilling to make appropriations allowing some latitude for effective and ornamental fixtures.

Street lighting with gas and gas mantles has conventionalized fixtures which are luminous in the upper hemisphere, and some of the metropolitan lighting companies have found it necessary to supply ornamental fixtures embodying this feature for their boulevard and parkway lighting.

For such work, the Edison Electric Illuminating Company, of Boston, is using a fixture with a 12-inch opal dome resting on a framework to which is attached a ring supporting a clear glass bowl, and with a hinge and catch to admit of

access to the lamp. Since this fixture is suspended from a gooseneck, additional problems in construction were encountered, as for instance, much ingenuity was exercised to provide a ready means of replacing the opal dome without disconnecting the wires, or for that matter, removing the lamp from the socket, where this work must be done after dark. To accommodate the heavily insulated wires concealed in the gooseneck, it has been necessary to use 1 1-4 inch iron pipe and a large high-tension insulating joint which has been designed to harmonize with the outlines of the fixture. So considerable a weight on a four-foot gooseneck requires a brace which is afforded by a wrought iron scroll around a medallion bearing the company's cypher.

A fixture of a similar design is being used along one of the principal driveways in New York with however, a 15-inch opal dome and clear bowl supported on a lyre-shaped top to an ornamental iron pole. A convex opal glass deflector rests on the framework above the lamp and while screening the upper construction admits light to the dome.

With the more general illumination of streets and public places with tungsten lamps, accessories multiply. Fixtures are suspended from goosenecks of varying spread and at distances of from 9 to 20 feet above the street level; are hung from crooks fitted to the tops of wood or iron poles, or from mast arms to bring them above the middle of the street. The writer has before him a design of a fixture with a series socket and lamp, intended to rest under an inverted 14-inch ball on the top of a low ornamental post of elaborate design in either iron or concrete; the design for a fixture to be used in an especially exposed location with a weatherproof globe over the lamp and under a reflector; and also a sample of a fixture with a cluster of seven large series sockets and lamps set in a 24-inch convex deflector.

Much might be said about the use of high tension mica insulating joints in preference to glass insulators with iron hangers, for the sake of appearance and as an added factor of safety, about goosenecks for concealed and line wiring, three hole flanges to prevent swaying, and points in construction making for convenience, all of which, however, would better be left to the preference of the individual buyer.

## Mr. F. M. F. Cazin

Mr. F. M. F. Cazin died at his home in Upper Montclair, N. J., on November 26th. He is survived by a widow, two sons, and two daughters.

Mr. Cazin was born in Aachen, Germany, February 22, 1827. He was descended from the stock of the old Helvetian race, which, as every school boy knows, as far back as Cæsar's time, "excelled all other Gallic races in manners, customs, and laws." He was educated in Germany as a mining engineer and metallurgist, and followed his calling for some years in Europe. He came to this country in 1867 and was connected with a number of important mining enterprises. He has been a frequent contributor to prominent scientific and technical societies and the technical press, his writings covering a variety of subjects. He discovered what he called the "law of continuous displacement," i. e., the resistance of a liquid to a body moving through it, which has been generally adapted by naval architects and constructors.

During the last sixteen years of his life Mr. Cazin gave his attention to the problem of finding a more efficient filament material for incandescent lamps, during which time he took out several patents involving the use of the rare metals and their oxides for this purpose. After working on the problem for eleven years Mr. Cazin, feeling that he had not received justice at the hands of the technical press, published at his own expense an account

of his researches and financial experiences in a small book under the title "What Next in Electric Lamp Making?" One of the introductory paragraphs is characteristic of his attitude toward the manufacturer and financier:

"Reviewing the history of my work * * * nothing is more deeply impressed on my mind than that the greatest impediment to an inventor * * * is not of a technical nature, and not of a financial nature, but in the fact that public morals, though they will condemn the jumper of a mine claim, will smile on the jumper of an inventor's claim * * * and will condemn the pirate and thief of material goods, but not the schemer who, by deception and sharp practice, appropriates to himself the fruit of another man's inventions."

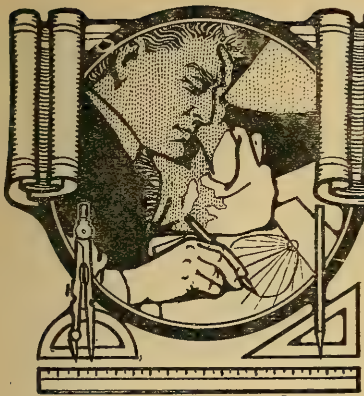
In the same introductory passage the writer also says: "Early in 1892 I conceived the idea of utilizing my special studies in this specific line for the improvement of the electric vacuum lamp in general, and its carbon filament in special, involving from the start electrolytic deposition of non-malleable, practically infusible metals on a core in the shape finally wanted in the lamp, on carbon or on wire of malleable metal, and discarding or absorbing such core."

It was along this line that all of his experiments were conducted, i. e., with the idea of electrolytically depositing some of the infusible metals on the ordinary carbon filament, and then either displacing the carbon by heat or coating the filament on the outside with metallic oxide. He went so far in his work that a company was formed, and the manufacture of lamps actually begun, in Amsterdam, New York, but through some unfortunate combination of promoters and capitalists internal dissension in the company arose and the enterprise discontinued before any of the product was marketed. Mr. Cazin claimed to have produced lamps which showed an efficiency of two watts per candle with a life of

F. M. F. CAZIN.

600 hours, results which had never before been attained in an incandescent lamp. Although several offers were made Mr. Cazin after the discontinuation of the Amsterdam concern, none of them were accepted, and the commercial introduction of the tantalum and tungsten lamps not long after overshadowed the results of his ten years of labor. The fact remains, however, that Mr. Cazin was one of the earliest workers along the lines which have proved revolutionary in electric lamp making; and his idea of constructing a filament of the infusible metals, which are non-malleable, by depositing them upon a carbon core, and then displacing the carbon, is substantially the same as one of the processes now used in making the tungsten lamp.

Mr. Cazin was a strong personality; a stranger to fear, both moral and physical; a resourceful scientist and inventor; a genial and entertaining conversationalist; and an aggressive defender of his own conceptions of right and justice.



# Practical Problems in Illuminating Engineering

## Show Window Illumination With Tungsten Lamps

By Norman Macbeth

Give a competent window dresser the choicest goods and unless the window is properly illuminated, of what value is either the skill displayed or the quality or novelty of the goods?

It is efficient and effective illumination which makes possible the final touch of suggestion for ownership to the purchaser who otherwise might not be interested in that which, without adequate illumination, may be a mere hole in the store front enclosed with glass.

Architects and builders have apparently given very little consideration to this important question. The space in the window at the disposal of the window lighting specialist is frequently not sufficient to hide a 16 candle power lamp alone, without considering the accessories necessary. Undoubtedly there has been and is still a very considerable amount of guess work and ill-directed experiment in window illumination.

Windows high or low, shallow or deep, are frequently given the same treatment. Windows containing dark goods adjoining displays of light goods are given the same flux or quantity.

Little attention has been given to switch control, reflection co-efficients of materials or fabrics, quality or quantity of either goods or light. Windows finished in light woods or decorations have been properly and sufficiently illuminated but when the style of decoration changes to mahogany or dark oak, the illumination falls off so much that the man who designed the window lighting, or the Company supplying the electricity or gas comes in for severe condemnation on the grounds of depreciation in the accessories, or gross carelessness in permitting the pressure of the supply to drop off to the "hot wire" point. Seldom is the fact made plain that because of the darker finishes a corresponding increase in intensities or change in distribution is necessary.

There are times when these conditions are reversed, and again the parties above mentioned come in for condemnation, on the grounds of extravagance or for increasing the pressure of either gas or electricity to run up bills. The merchant who has always handled the lighting of his store as he superintends the other departments—by observation of past performances—notices a well lighted window downtown, makes careful note that ten reflectors with such a number of a certain kind of lamps are used and orders his contractor to install a similar outfit for him.

The result is not as anticipated, all the present appropriation for window alterations is used, and further expenditures cannot be considered this year. The result is little better than before the change was made. As likely as not the structural conditions and size of the windows differed greatly as did also the goods displayed, the factors which should have received the most careful consideration were overlooked.

The problem of window illumination has two sides, the physical and the physiological.

A window may have the right kind of lamps, the correct amount of flux or quantity of light, but because of the physiological effect be condemned. Many in-

stallations waste light in outline effects, by studded ceiling and other methods which, if used properly, would efficiently do the work and leave a fair amount to charge off on the investment. The sense of seeing is dependent upon differences in the intensity and quantity of illumination reflected from the goods to the eye of the observer.

To secure the best results, window illumination should be by both direct and diffused light. The direction must be natural, which means invariably from the front and above. Shadows are necessary, but should not be sharply defined. We should have no difficulty in distinguishing objects in a shadow nor confusing the edge of an object with the edge of a shadow. This condition is quite noticeable in a window lighted with a high candle power miniature arc lamp hung in the center of the window, and equipped with the light alabaster globe so frequently used.

Various reliable investigators have stated that the eye is working at a normal pupilary aperture and condition when one to two foot-candles is effective on the eye, reflected from the object viewed—the object (the goods in the window) being considered as a secondary light source. Therefore goods reflecting 80 per cent. of the illumination received should be allowed about 2½ foot-candles effective. Dark goods from which the reflected light may range from 5 per cent. to 1 per cent of the total flux effective on the goods, would require from 40 to 100 foot-candles for satisfactory eye conditions; that is to see clearly without strain or fatigue, having 1 to 2 foot-candles effective at the eye.

In the clothing section of the windows described in the August number of THE ILLUMINATING ENGINEER, with a maximum of 40 foot-candles on the floor of the window, and an intensity which could not have been less than 80 foot-candles at a height of three to four feet, the amount

FIG. 1.

FIG. 2.

FIG. 3.

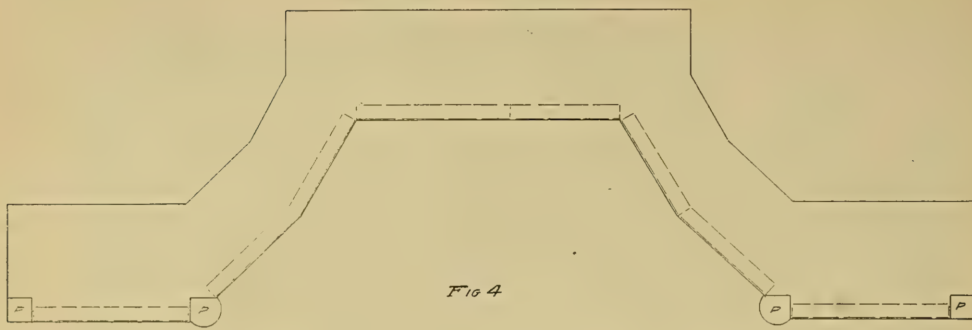



FIG 4


FIG 6.

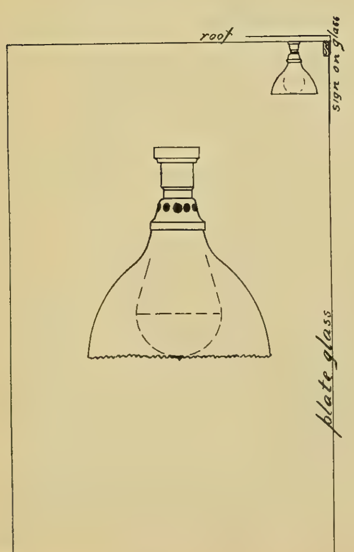



FIG 7.

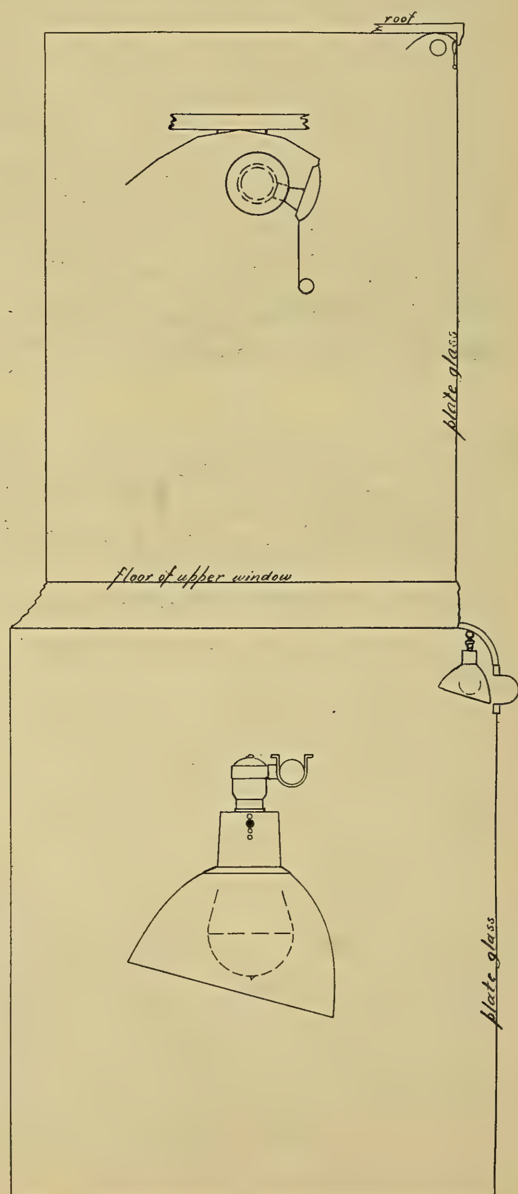



FIG 5.

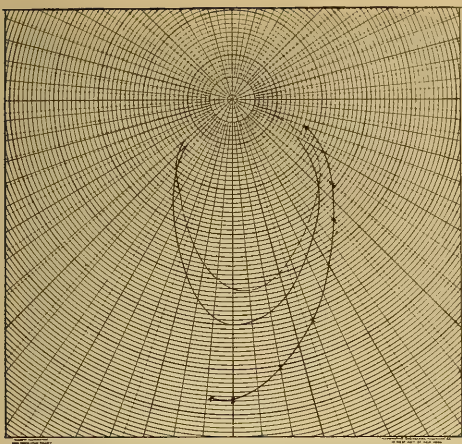


FIG. 8.

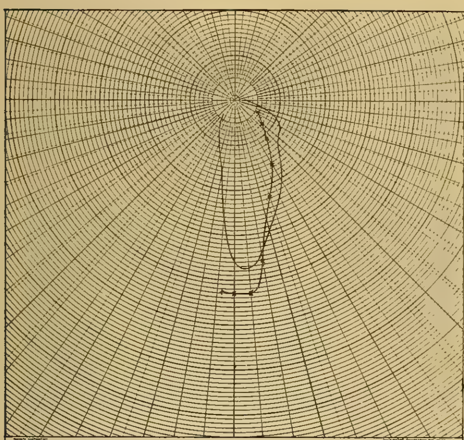


FIG. 9.

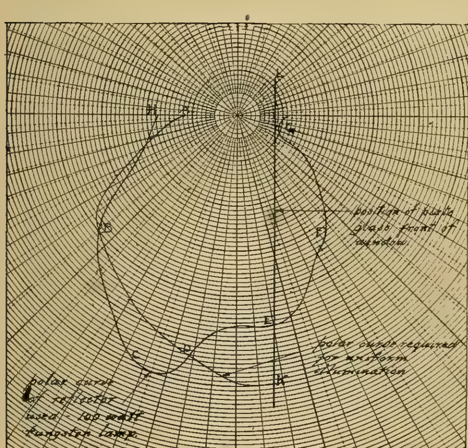



FIG. 10.

reflected as measured on the illuminometer screen on the sidewalk at the height and distance from which the eye would ordinarily observe the goods displayed, varied from 1.5 to 1.8 foot-candles.

The tungsten lamp probably more than any other one factor makes possible a standard of window illumination nearer to approaching the satisfaction point than has ever before been possible. First, because of the comparatively large flux of light available per unit of space occupied; second, the quality of the light; and third, the high efficiency. The latter permits the installation of higher intensities for the equivalent electricity costs of carbon filament lamps.

Would any merchant be justified in spending $5,000 per year in newspaper advertising for a store having an annual rental of $10,000 to $15,000, to say nothing about other fixed charges, and economizing on his window lighting, admittedly an advertising proposition of greater value by many times than newspaper space, and taking the savings due to the greater efficiency of tungsten lamps, when by the expenditures of the same quantity of electricity (at a cost of 65c. per night of five hours, $200.00 per year, with electricity at 10 cents per kilowatt hour) in a window of the average size and kind in the average small store, having a fifteen to thirty-foot front, on a busy street, he can have a window well illuminated?

The windows shown in Fig. 2 were lighted with mirror trough reflectors of the half circle type and standard 16 candle power carbon filament lamps. These troughs were installed in a horizontal position in the front of the windows and several were used vertically between sections. In addition to these there were used in the lower part of the upper front section linear filament lamps with a wide semi-circular reflector lined with opal glass.

The net result was probably slightly better than is shown by the photograph, although the illumination furnished by the enclosed arc lamp on the inside of the store as may be seen through the door, does not show an undertimed negative or print.

In Fig. 2 the goods shown in the upper front section were illuminated solely from the street as these goods were dressed ap-

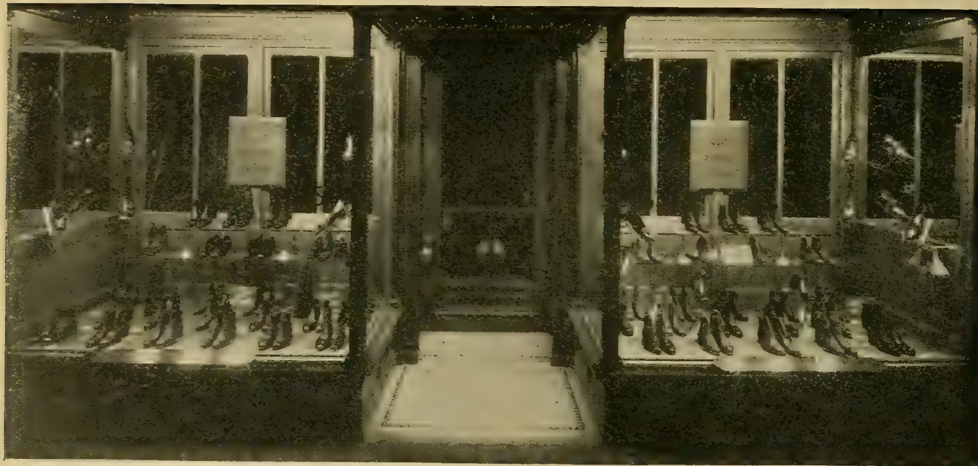


FIG. 11.

proximately six inches forward of the trough installed, same being eighteen inches in from the plate glass, evidently because a break of sufficient depth had been left in the window ceiling at that point, into which the trough seemed naturally to belong. The hemispheres of striped opalescent glass each contained three 16 candle power lamps. These were disconnected, but had not been taken down


FIG. 12.

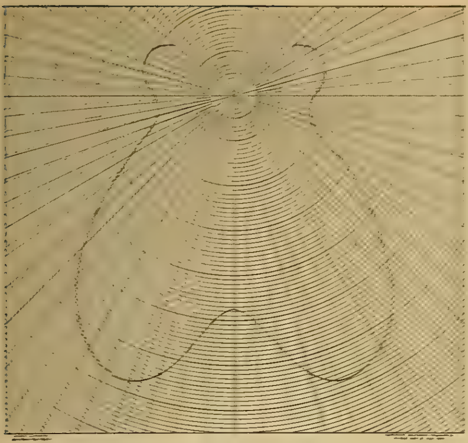


FIG. 13.

when photographs Figs. 1 and 3 were taken, but because of the light reflected on them they appear to be in use. Reference to the hemispheres in the upper front sections, however, show that they were not lighted but illuminated.

Fig. 4 shows the plan of the upper section, the lower section structural difference being readily apparent in Figs. 1 and 3. For the lower sections special light weight metal reflectors were designed, giving the wide and concentrating distributions shown by the solid and dotted line curves on Fig. 8. This reflector and the method of securing these various distributions is shown in the lower part of Fig. 5, which also shows the reflector position relative to the window. This reflector when attached to the shade holder with the set screws in the upper position, gives the solid line curve in Fig. 8, the lower third set of holes give the wider distribution shown by the dotted line. These measurements were made and the reflectors installed with 100 watt frosted tip tungsten lamps. The two other positions available were used to vary the distribution between the wide and concentrating values shown. The solid line with the crosses, Fig. 8, is the average specification curve calculated.

In the upper windows, the roof of the sections shown in the center of Figs. 1 and 3, was less than six inches above the top of the plate glass. This condition required a special working out and was admirably met with a mirror trough reflector of section shown in upper part of Fig. 5. The distribution curve of this reflector is shown by the solid line curve in Fig. 9 and closely approximates the specification curve shown by the solid line with crosses. The specification was made to take care of goods dressed up quite close to the glass. Tungsten lamps of the 40 watt and 100 watt sizes are used in a horizontal position.

This installation has been in use two months about five hours per day and the only lamp which failed to stand up was one used in a pendant position in the lower window, which blackened in less than fifty hours' use. The flux allowance was one-third less in the upper than in the lower windows where better illumination was thought to be necessary to enable observers to note detail, which would not be possible or necessary in the upper sections owing to the greater distance and class of goods there displayed. The total wattage is 15 per cent less than that formerly taken by the carbon filament lamps.

Fig. 6 shows detail of prismatic reflector unit with 100 watt frosted tip tungsten lamp and window section where same was used. The distribution curve and specification curve of this unit and window is shown in Fig. 10.

The window illuminated with five 100 watt tungsten lamps in each section is shown in Fig. 11. The extreme brightness appearing on the upper rear woodwork is a photographic distortion not apparent to the eye and is due to direct reflection, and not as might be supposed to a too great quantity of illumination where it is not only unnecessary but would detract considerably from the appearance of the window. The finish in this window is dark as is also that of the goods, and it is only when the intensity of illumination is noted on the mosaic floor in the doorway that its quantity is appreciated. The maximum in the window is between 20 and 30 foot-candles.

In Fig. 12 is shown a show window quite the opposite of Fig. 11 in interior finish. The white enamel and mirror finish, together with the white background, only need exposed light sources to present to the observer a dazzling glare. The sources are not exposed as may be noted in Fig. 7, which gives the detail of the window and of the prismatic reflector attached to a simple shade holder receptacle


FIG. 14.

as installed. The glare of bare lamps is missing but the intensity is quite high. The distribution curve of the unit used in this window is shown in Fig. 13, the right half of the light flux shown by this distribution curve was counted on to build up the intensity in the front of the window, the greater amount striking the plate glass at an angle from which it would be reflected back into the window. Seven units are used in this window, part 100 watt and the rest 60 watt tungsten lamps. Undoubtedly less electricity could be used, but the monthly costs for the store where artificial light by tungsten lamps is used all day long, and in the window to midnight, six days a week, are so satisfactorily low that a reduction would not be considered. In the four tungsten windows shown in Figs. 1, 3, 11 and 12 the illumination is directed from the front and above, the shadows are softened and natural and the general and detailed effects secured are satisfactory to those using them. All the photographs of the windows shown were taken between 8 and 10 P. M., at least two hours after sundown, under their regular conditions of illumination.

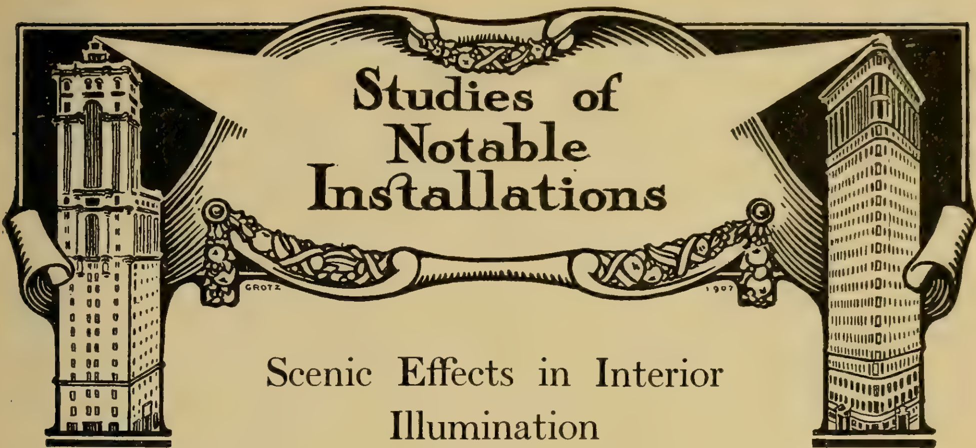
Photographs Figs. 12 and 14 were taken on the same night within a few minutes of each other, with the same camera, time of exposure and stop, using the same make of negative and printing out as nearly as possible under the same conditions.

The difference between a satisfactorily and a poorly illuminated window when tungsten lamps are used cannot be compensated for by the slight comparative difference in maintenance costs.

Would a window similar to that shown in Fig. 14 be a better investment than the window, Fig. 12, where the conditions of white finish, mirror back, and white background with a flat shoe trim are quite similar, if a saving of $6.50 per year per foot of window frontage, fifty-four cents per month, can be effected?

Possibly it was believed that handsome fixtures might compensate for the lesser illumination, although the old adage should be as true today as ever:

"Handsome is as handsome does."




# Studies of Notable Installations

## Scenic Effects in Interior Illumination

The marvelous realism and beauty of the present day stage setting is due as much to the skillful use of artificial light as to the ingenuity and artistic treatment of the properties and scenery. In many a production the stage settings and scenic effects are a "whole show" in themselves, and would be well worth seeing without the actors as accessories. The feasibility of utilizing the fascination of scenic decoration and lighting as a means of attracting the public to restaurants and cafes has become quite generally recognized. The "orangerie" in the Hotel Astor is one of the early installations of this kind, and was described

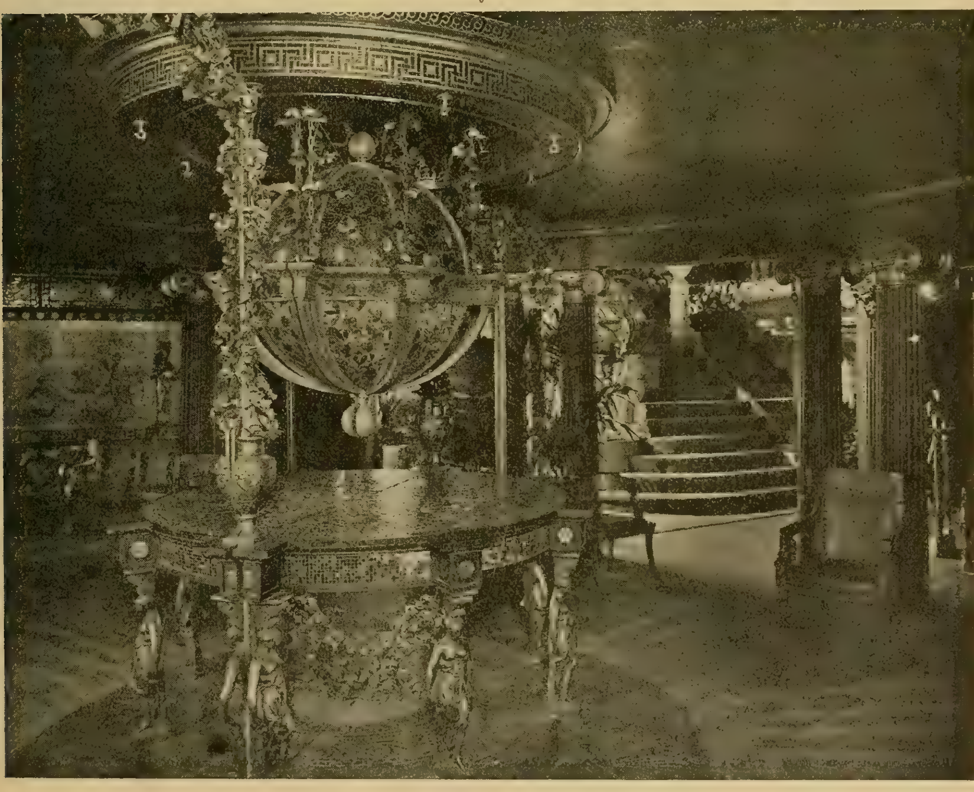


FIG. I.—ENTRANCE MURRAY'S ITALIAN GARDENS.

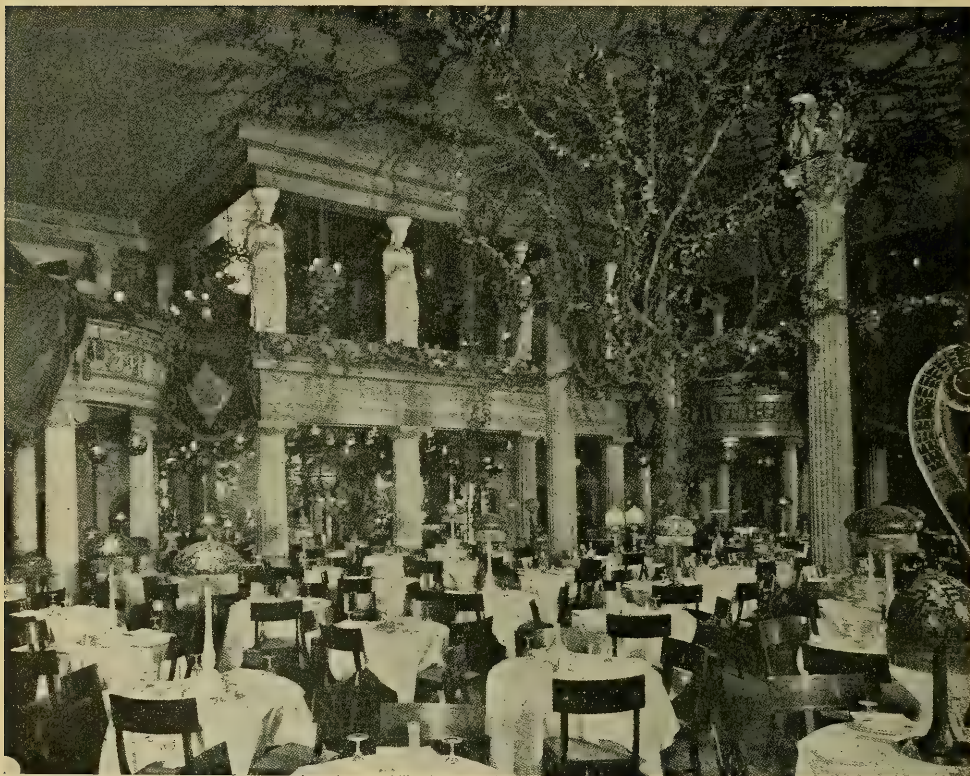


FIG. 2.—MAIN RESTAURANT.

in the first issue of THE ILLUMINATING ENGINEER. One of the most famous and elaborate examples of scenic decoration and lighting is that of Murray's "Italian Gardens," on 42d Street (New York), in the very heart of the theatre district. The building was originally a school house, but under the magic hand of Mr. Henry Erkins, this architectural desert has been literally made to blossom like the rose. The place is an interesting study in optical illusion, as well as a thing of beauty. By the clever use of mirrors and lights a comparatively small floor space has been transformed into what is apparently a garden "as big as all out-of-doors."

Something of the general effect, and the methods used in securing it, may be seen in Figure 1, which shows the entrance, or foyer. The photograph, which was taken from the outside door, shows the first view obtained on entering. You are apparently in a large square room containing a round table in the centre, over which is suspended a large globe of bronze and leaded glass. To the right is the main passageway into the restaurant, and a stairway leading to a mezzanine floor. To the left is seen a mural painting. The table top is of leaded glass in the rich orange and red tints, and is luminous from incandescent lamps placed underneath, while the globe above is mostly in green. Now, this apparently large room, instead of being square, is in reality a right angle triangle, being cut in two by mirrors placed diagonally across. The table is semi-circular, and the globe above it a hemisphere, each being placed against the mirror forming the walls. The joints of the separate sections of the glass are deftly concealed by the festoons of vines. The mural painting at the left exists only as a reflected image of the actual painting on the wall at the right, not shown in the photograph. Likewise, the apparently double stairway is only the reflection of the single stairway in the mirrored wall. An observer standing at the foot of these stairs and looking into the foyer, apparently sees a room having two similar entrances; one

FIG. 3.—THE FOUNTAIN.

immediately in front, and one at the left, the former being the reflection of the latter in the 45 degree mirrored wall.

Passing to the main floor restaurant, and looking to the left, the scene shown in Figure 2 meets the eye. In this everything is real except the vista under the gallery, which is due to reflection from mirrors. The ceiling is pierced with small star-shaped openings behind which are placed electric lamps, which are alternately lighted and extinguished, giving the appearance of twinkling stars; while the marvelous effect of moving clouds, which that wizard of stage lighting, Mr. Charles De Soria, first introduced in the New York Hippodrome, adds to the realism of the outdoor effect.

Looking to the right from the same position, the view shown in Figure 3 meets the eye. In the centre is an apparently circular portico facing a fountain. The steps of this portico, over which the water flows, are of stained leaded glass illuminated from within. In actual fact this fountain is but a quadrant of a circle, being placed in the corner of the room against mirrored walls. From the centre of the ceiling of this room there is suspended an enormous bronze and stained glass globe lighted from within.

Another view, which shows the sky effect of the ceiling, is given in Figure 4. This also shows the location, but not the form, of the chandeliers which are hung from the ceilings over the mezzanine, and also underneath. These are three and four light bronze fixtures of Pompeiian design. It will be seen that the tables are generally individually lighted with portable lamps, all different, and of exquisite design. A portion of the tables however, —those which have no portables,—appear to be set with decanters of sparkling wine, wine that literally sparkles with light. Closer examination shows that they are simply carafes of water placed on the top of the table, directly over a red electric lamp bulb.

The general illumination is by no means brilliant; brilliancy would be out of keeping with the artistic atmosphere of the place, as well as a menace to the ocular deception which constitutes its greatest

FIG. 4.—AFTER THE THEATER AT MURRAY'S.

charm. The chief feature of this deception is the effect of distance and perspective given to the entire treatment. Thus, the mural paintings, which are reproductions—and very excellent ones—of modern masterpieces, are set slightly back of the supporting columns and their lintels. These are brilliantly lighted by means of "Linolite" lamps and reflectors concealed behind the apparent masonry. The effect of this brilliant illumination from concealed sources is to throw out the painting into exquisite relief and give it an "atmosphere" that would be absolutely wanting were it on an evidently flat wall surface. Closer examination shows that not only has the lighting been concealed, but that the lamps themselves are stained with different colors so as to enhance the colors of the painting. This is a trick in picture lighting with which very few illuminating engineers are familiar, and if suggested to an artist who had never seen the scheme actually carried out, would be sure to meet with vehement protest. The fact remains, however, that not only may the color values of a painting be so distorted by ordinary electric light as to seriously mar its beauty, if not actually to wholly destroy its real merit, but that by a skillful and proper use of colored lamps its beauties may be even more vividly brought out than by daylight.

The fountain shown in Fig. 3 is likewise thrown into relief by the use of "Linolite" lamps concealed behind the ostensible columns. Probably the cleverest use of all made of this form of concealed lighting, and which could not have been accomplished by any other lighting unit, is to illuminate the branches of the trees and festoons of vines. This is adroitly done by painting the reflector the same color as the branches or leaves and installing it in such a manner as not to be apparent. Together there is some 800 feet of "Linolite" units in the installation. In actual effective candlepower this undoubtedly represents the major portion of the total illumination, so that, from an engineering standpoint, the general illumination may be considered as of the indirect type.

# Fixtures and Accessories

## Home Lighting

Furnishing a home should be something more than merely equipping a house with the necessities, and as many of the luxuries as may be. Every item that enters into it, whether in the nature of moveable furniture or permanent decoration, should mean something to the occupant, and have as distinct a personality. The question of utility, of course, must not be wholly despised; but if we were to consider this only we could return to the caves of our primeval ancestors without sacrificing many of the essentials. So far as conditions will permit, the home furnishings should be a collection of those things which we most admire and most like to possess; and it is with this idea that we wish to briefly consider the question of home lighting.

Let us start out with the fundamental proposition that the lighting of a home is a part of its furnishings, and not a part of the architecture. The building may exist and fulfill every one of its functions without artificial light at all. There is neither logic, nor sense, nor historic precedent for considering the lighting fixtures as parts of the structure; and the contrary notion is responsible for no small number of monstrosities masquerading as lighting fixtures, but more usually in connection with public buildings than in domestic architecture.

Our second proposition is not less important, namely, that the lighting fixtures are a very important part of the furnishing, being both conspicuous and useful. Like the frame of a picture, they can make or mar the entire effect. It is related that some great painter—it does not matter who—had completed a picture, and stood back gazing at it in deep contemplation. While he could not detect any single fault in color or drawing, yet the picture as a whole lacked something. At last, in anger at being unable to supply this manifest lack, he threw his brush at the canvas. The brush left a crimson spot where it struck, and, behold, the picture was complete! The one touch of color necessary to give life to the whole composition was there. The lighting of a room is this spot of color that can bring out and complete the entire picture. But it must be rightly placed; had chance directed the artist's brush to another place on the canvas, it would have produced simply a staring blotch instead of the finishing touch.

In lighting the home, economy is not the one cardinal virtue. The home is furnished with the things that we most admire and prize, within the limits of our means, and not a mere storage place for bargain-counter purchases. Poverty is being deprived of the things we like; and he is poor indeed who does not gratify his wants to some extent in the furnishing of his home.

The candle is admittedly an extravagant light-source, and yet by reason of its associations it cannot be supplanted by any of our most modern triumphs of scientific discovery. Though we may imitate or simulate the candle with our modern luminants, they can never quite have the feeling that attaches to the genuine article. An electric lamp is brilliant and useful, but it conjures up no pictures of the past. There is no poetry in it; and if we are to discard sentiment altogether let us admit at once that we are slaves and be done with it. The most efficient lighting of the home is the one that pleases us best, that contributes most to our pleasure in having a home and being in it.

What are a few dollars or cents more or less in a lighting bill compared with the gratification of the home sentiment?

At the present time the two periods of architecture and furnishing that are most in vogue are the Colonial and the Mission. The reason for their popularity may be found in two different motives; first, they represent the oldest types in America, and therefore have the value of historic association; and secondly, they are essentially simple, even to severity, and there is a natural tendency always to turn toward simplicity. "All is vanity, saith the preacher." Florid over-wrought decoration may attract the eye for a time, and satisfy the desire for novelty, but so sure as old age must follow youth, so sure will the mind tire of superficialities, and seek the repose of simplicity.

Colonial architecture is an adaptation of the classic Greek, the comprehensive motive in which was simplicity of line combined with dignity and majesty of proportion. The adaptation of such motives to dwelling house construction resulted in a certain austerity, which well befitted the character of the American colonists. This phase of character expressed itself somewhat differently in the southern, or Virginian, and the northern, or New England settlements. In the former, it was the austerity of wealth and rank; in the latter, the austerity of religious devotion. In the southern there was something of the magnificence of the Grand Seigneur; in the northern, the elegant simplicity of the Puritan. Whichever of these types of architecture is carried out in the modern dwelling, the character of the furnishings will naturally partake of the spirit of those who first builded and dwelt in its prototype.

Probably in no distinct architectural type of building has there been so little true taste displayed in the design of lighting fixtures as in the Colonial dwelling. Our forefathers in the Georgian period had neither electric lamps nor gas; the whale oil lamp and the candle furnishing the source of light. Such attempts as have been made to adapt our modern light-sources to the Colonial dwelling have usually been complete failures, from the fact that designers have attempted to adapt the structural features of the architecture itself to them, instead of considering them as parts of the furnishings. The motives for fixtures designed for domestic use are to be found, not in a study of the architecture, but of the furnishings that were used in the period of which the architecture is a reproduction or adaptation. The principal furnishings of this kind are candelabra, chandeliers, tableware, and fire-place fittings. The candle sticks and candelabra of the Colonial period varied in design from the extreme simplicity and quaint outline of the Dutch, through the graceful and somewhat more elaborate forms of the English, to the elegant and ornate motives of the French. The latter is connected with the southern Colonial; the former with the northern; while the Dutch was more evident in the intervening territory.

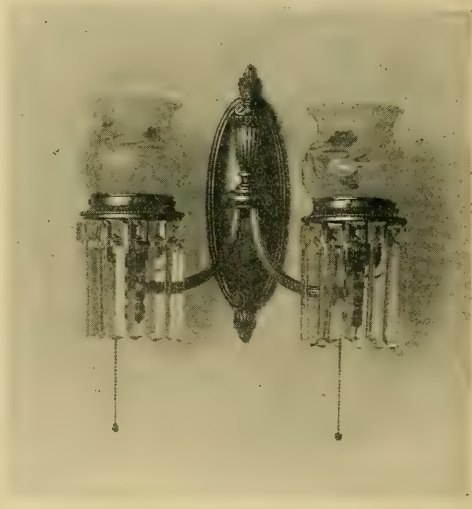


FIG. 1.—COLONIAL BRACKET WITH OIL LAMP EFFECT.

A modern electric bracket taking its motives from the Georgian, or English, style, is shown in Figure 1.

Figure 2 shows a combination of several decorative motives which are very characteristic of the French influence in the southern Colonial.

Among the metal objects which are particularly rich in decorative motives adaptable to fixture construction, the Sheffield plate is particularly worthy of study. There are few specimens of the artisanship of the Colonial period that are more

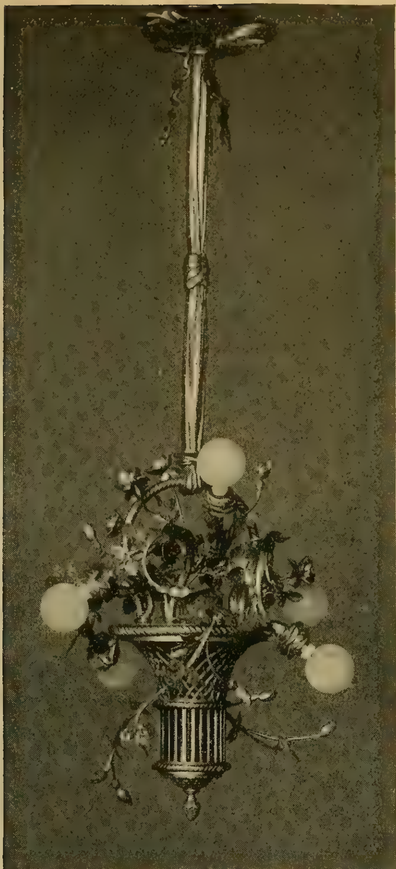


FIG. 2.—AN ADAPTATION OF ELECTRIC LAMPS TO SOUTHERN COLONIAL DECORATION.

highly prized at the present time than the exquisite pieces of the Sheffield silversmiths. The designers of candelabra in the Colonial period showed a keen appreciation of the sense of proportion. There was never any clumsy overloading of their designs with metal. The construction was adequate to the purpose, but gave not the slightest suggestion of disproportionate strength and weight.

As to the metal itself, there is no question as to the desirability of silver in fixtures which follow the motives of the Sheffield ware, or which are designed for use in the English Colonial. For the southern Colonial, however, which followed the French, dull gold will naturally be chosen; while uncolored and unpolished brass is of course the one appropriate metal for the Dutch designs.

In attempting to produce a fixture for modern light-sources to harmonize with Colonial architecture and furnishings, the fixture designer has rarely ventured beyond a simple imitation of the actual candle. If such imitations are to be used, the likeness must manifestly be sufficiently close as not to at once proclaim the fact that they are imitations. The miniature incandescent lamp having a pointed bulb is fairly acceptable as a representative of the candle flame; but the use of a rounded lamp of 8 or 16 candle-power is simply grotesque. There is nothing so ludicrous as a tragedian who just falls short of being tragic; so in decorative art; the ordinary electric lamp on top of an opal glass tube posing as a candle is simply a farce. When chandeliers were used in Colonial times they commonly depended upon glass prisms and pendants for their decorative effect; and these "lustres," as they were appropriately called, are as worthy of study today for purposes of adaptation to modern lighting fixtures, as are the unsurpassed designs of the Sheffield artisans.

As showing that our fixture manufacturers have not arisen to the occasion in supplying suitable designs for domestic Colonial architecture, the following incident may be related:

An owner who was furnishing a Colonial dwelling of the better class called upon a fixture manufacturer. After looking over a number of designs for brackets, he said: "I have been to all of the prominent manufacturers, and have found nothing that is wholly satisfactory. This bracket design comes *nearest* to my ideas of any that I have seen, although it is not *just* what I want. However, I suppose that as this is the best I can do, I shall have to take it." The designer was called in, and after some questioning as to the conditions, convinced the owner that he was by no means obliged to take anything that did not exactly come to his ideals; that while the precise design which he had in mind might not have already been constructed, it was possible to produce a design that would be exactly what he wanted. As a result a thorough explanation was given of the conditions, and a special design was worked out, which completely realized his ideas.

# Theory and Technology

## Plain Talks on Illuminating Engineering

By E. L. Elliott.

### No. 17. — Calculating Illumination by the "Flux of Light" Method (*Continued*)

The lumen is quite rapidly becoming used when a fractional part of the entire light given out from a source is handled, and, all things considered, is the better unit to use in such cases. The spherical candle is the most convenient unit for measuring flux of light when we wish to compare the entire flux or output of different light-sources.

In laying out an installation it is often advantageous to make some preliminary calculations to determine the total quantity of light required; the distribution can then be taken up as a separate problem. For example, if we have a surface of 100 square feet which we wish to illuminate with an intensity of two foot-candles, we see at once that we shall require 200 lumens of light to produce the general result. The remaining part of our problem then contains two factors: first, the selection and location of light-sources which shall throw 200 lumens of light upon the required surface; and, second, such an arrangement that the distribution of intensity over the surface shall be uniform or fulfil any other given requirement. It will at once be apparent that it is not sufficient to simply select a light-source giving 200 lumens and hang it up over the given space; the 200 lumens must be given out in such directions as to fall upon the given surface. This may be, and usually is, only a portion of the total flux or quantity of light given out. The two quantities are commonly distinguished as "lumens produced" and "lumens effective," and the ratio between these two quantities expresses the illuminating efficiency of the light-source with its accessories.

In order to apply this method we must first understand how to determine the number of lumens given out from a source within any given angle from the vertical. The first step toward this determination is of course a distribution curve of the given unit. With this curve as a basis, the lumens of flux within any given angle from the vertical may be determined. As the total flux is found by taking the average intensity of the light over the surface of an entire sphere, so the flux over a part of the surface of a sphere is determined by taking the average intensity over that part, multiplied by the area of the surface of the part. In order to determine the average intensity over part of the sphere, the same principles hold as in finding the average intensity over the whole sphere, i. e., mean spherical candlepower.

An illustration which may help to make this matter of spherical, hemispherical and "zonular" candlepower clear to those not accustomed to think in mathematical terms is as follows:

Suppose that we wish to determine the

average radius of the earth. The correct way to obtain such a mean radius would evidently be to level down all the mountains; in other words, to bring the earth to a uniform sphere containing the same amount of material, and measure the radius of this sphere. Suppose now a range of mountains running around the equator: they would evidently contain a much greater amount of earth than a range of equal height around the polar circle, for example, and still enormously more than a single mountain at the Pole. In our imaginary leveling-up process, therefore, it would take a comparatively small reduction in the height of this equatorial mountain range to produce a proportionately large filling up of the regions near the poles. Now imagine a solid formed by revolving the distribution curve of an ordinary electric lamp about the vertical line: you will have a more or less spheroidal body. The mean spherical candlepower may then be conceived as the radius of this spheroidal body when leveled up into a perfect sphere having the same cubic contents.

To obtain the lumens, or portion of the spherical candlepower for any part, say, for 60 degrees from the vertical, imagine a line drawn around this spheroidal body at the given angle, and the body to be sliced off at this line. We must then imagine the portion cut off to be shaped into a body which is a corresponding part of a perfect sphere, the radius of which will then represent the average intensity through the given angle; this intensity multiplied by the surface of the body will give the flux in lumens.

The conception of mean spherical candlepower and its fractional parts is by no means a simple matter, and can be accurately handled only by the use of higher mathematics. Methods of sufficient accuracy, however, for all practical purposes may be used without attempting to fully understand the mathematics of the case. It is always worth while, however, to get the clearest conception possible of all calculations and mathematical work.

Since the distribution curve is always obtained from a limited number of measurements of intensity, it is necessarily in itself an approximation, the intensities between the angles at which they are actually measured being assumed. The drawing of a curve through the points representing the actual measurements is simply an aid to determining the most probable values between these points. Since the measurement of flux in lumens in all cases depends upon arriving at an average candlepower, or intensity, of the solid angle or zone to be measured, the result is necessarily based upon some method of approximation. The accuracy of such result must therefore depend upon the number of actual measurements which enter in to the approximation.

There are a number of methods of obtaining such approximations: one is to draw the complete Rousseau curve (see "Plain Talk, Number IV, Page 715, Volume 1); the lumens for any given angle can then be obtained by taking the area of the Rousseau curve within this angle. A much simpler method is to use the "polar-flux paper" designed by Mr. Norman Macbeth and described on page 214 in the June issue of this year. The distribution curve can then either be drawn on this paper or a tracing of the dotted lines may be made on tracing cloth to be used for distribution curves drawn on other paper. Suppose we wish to determine the flux for 60 degrees, i. e., the lumens given out from the vertical to 60 degrees above. We read the intensities within this angle at the points where the dotted lines cross the distribution curve. This gives us five quantities; add these together and divide by five to obtain the average; multiply this average by 3.14 (see table below); the result will be the number of lumens.

A special adaptation of the method just described to the determination of the lumens for any given angle has been suggested by Cravath and Lansingh. It consists simply in dividing the given angle into ten divisions, drawn on the same principle as the dotted lines on the "polar-flux" paper, i. e., at such angles that the sum of the intensities read off at their intersections with the distribution curve divided by ten will represent the average intensity throughout the given angle.* This average intensity, multiplied by a quantity determined by the use of trigo-

*Complete data for drawing these will be given in the next issue.

nometry, gives the number of lumens. The following solid angles, i. e., the portion of the whole sphere included between the vertical and the angle, and the multiplying factors corresponding, are as follows:

| | |
|---|---|
| 30° | .842 |
| 45° | 1.84 |
| 60° | 3.14 |
| 75° | 4.65 |
| 90° | 6.28 |

The angle of 60 degrees has been taken in these examples for the reason that it is the light within this angle that may be most generally effective in producing illumination.

Conversely, the effective lumens, i. e., the light actually used in any given ininstallation, may be determined by measuring the intensity in foot-candles on some chosen plane at a sufficient number of points to obtain a fair average, and multiplying this average intensity by the area. Thus, if we find an average intensity of two foot-candles, and there is an area of 500 square feet, then the amount of light falling upon the surface is 2 x 500, or 1,000 lumens. This gives a quantity from which the efficiency of the whole system or installation may be determined. If it is an electric installation, the total number of watts of electricity divided by the number of lumens gives the efficiency expressed in watts per lumen; or, if the division is made the other way around, in lumens per watt. If it is a gas installation, the number of cubic feet of gas burned would be used in place of the number of watts. Efficiencies thus expressed are *simple* ratios or fractions, and therefore much plainer and easier to express and understand than the method of using watts per foot-candle per square foot, which is necessary where the lumen is not used.

The efficiencies as above expressed show the relation between the amount of illuminant used and the effective illumination. There is another efficiency which is interesting as showing the efficiency of the lamps and their accessories as illuminating devices. This efficiency is the ratio of the entire flux of light generated to the flux which is effective in illumination. To obtain this it is necessary to know the mean spherical candlepower, i. e., total flux of each of the light-sources; obtain the sum of these quantities, reduce the spherical candlepower to lumens and divide this quantity by the number of lumens of effected illumination. For example, suppose in the case mentioned, in which there were 1,000 lumens effective, we had used 20 electric lamps, each having 13 m. s. c. p. We have then a total of 3,240 m. s. c. p., which, multiplied by 12.5 (to reduce it to lumens) gives us 2,700 lumens; dividing the lumens effective, 2,000; by the lumens generated, 3,240, we get 60 per cent. efficiency.

It woud be well if these different efficiencies, which are both important but of an entirely separate nature, could be distinguished by different terms. Some English authority has suggested that the term "duty" be used instead of "efficiency" to express the ratio of the lumens, or spherical candles generated to the luminant consumed. Instead of speaking of a high efficiency lamps we would then speak of a high duty lamps. This is a strange sounding term in illuminating engineering, but is commonly used in mechanical engineering. Thus, a high duty engine is one which gives a large proportion of work for energy consumed.

In order to make use of the flux method in laying out installations it will be a great convenience to the illuminating engineer to prepare a table giving the lumens effective within, say, 45 degrees, 60 degrees and 75 degrees from the vertical of the most common forms of units, i. e., light-sources and accessories, or standard lighting fixtures. Then, when any of these are to be used in a given problem, the number required can be determined by a few short and simple calculations, and likewise the quantity of electric current or gas necessary. Of course all this applies to cases in which only general illumination is required. The question of distribution, uniform or otherwise, quality of light as to color and diffusion, and the use of specialized light, are separate problems.


## Color Value As a Requisite In Photometric Standards

Not long since, Dr. Steinmetz presented a paper before a technical society, in which he outlined a plan for obtaining a standard light-source which should not only be constant and reproduceable in regard to intensity but should be a standard in color composition as well. The plan at least had the virtue of novelty and ingenuity; but, admirable as these two virtues may be in scientific research, they are not always sufficient to produce practically valuable results. It not infrequently happens that those who delve into the depths of pure science become so familiar with the more recondite and abstruse phases of the subject that they overlook the simpler and often more practical solutions of problems that lie upon the surface.

The advantage of producing a practical light-source which should be not only uniform in color but a fair equivalent of "average daylight" is perfectly apparent, and Dr. Steinmetz's essay toward producing such a standard is a recognition of the fact which of itself is of no little importance.

Before undertaking the very elaborate means which Dr. Steinmetz suggests, however, it would be well to thoroughly investigate the claims which are made for an artificial light which has already reached the commercial stage, namely, the Moore vacuum tube light. Studies made by such eminent authorities on color as Dr. Utzinger of Berlin and Mr. F. E. Ives, the inventor of the colorimeter establish the fact beyond question that the Moore tube, using pure carbon dioxide, gives a light which leaves nothing further to be desired in the way of a substitute for "average daylight" in point of color. Mr. Moore claims, moreover, that all of the conditions which determine the intensity, or rather the intrinsic brilliancy, of the luminous gas in the tube are susceptible of such positive and easy regulation as to render the light a practically perfect standard light-source. These conditions, as we understand it, consist of the determination of two physical quantities and one electrical, namely, the dimensions of the tube, the tension of the enclosed gas, and the voltage of the electric current. All of these conditions are susceptible of measurement to a very high degree of accuracy—vastly higher than the measurement of the luminous flux by any present method. The fact that this light has been perfected to an extent that has made it available for commercial use, and the simplicity which is claimed for the method of utilizing it as a standard light-source render it in every way worthy of the most serious and careful investigation by those who are especially charged with the matter of standards, such as the Bureau of Standards of our own government, the National Physical Laboratory of England and the Electrotechnischer Reichsenstalt of Berlin.

We have never considered it absolutely essential that a reproduceable standard of light be obtained. Our fundamental standards of length and mass are not reproduceable, but purely arbitrary, and the incandescent electric lamp seems to afford an almost equally reliable standard. However, if a standard *can* be obtained which is capable of exact reproduction, it will be a very valuable achievement, and will

place photometry, so far as the question of standards is concerned, at the head of all branches of the science of mensuration.

## The Progress of the Flaming Arc Lamp

If there is one thing that Americans pride themselves on, it is in being "up-to-date,"—of having the latest and best of everything. A little unprejudiced study of foreign methods, or better still, an investigation "*in situ,*" would cause this pride to take a considerable fall. In the matter of improvements in lighting we have been surprisingly slow and backward. Practically every one of the improved light-sources which we are just beginning to make so much noise about were developed and brought into practical use in Europe years ago; and some of the improvements which are established and important factors there today have not yet been tried in this country,—for example, intensive, or high-pressure gas lighting, and automatic system for lighting and extinguishing gas street lamps.

The flaming arc lamp was worked out to a high degree of perfection, and had reached a very extensive commercial development in Germany before it was even seen in this country; and when it did first appear, it was looked upon as a sort of spectacular contrivance, which might be a nine-days' wonder as a theatrical advertising sign. As such its success was instant, and its use grew at an astonishing rate. In the course of time it began to dawn upon illuminating engineers and others interested in practical illumination that this newcomer in the field must be taken seriously as a commercial light-source. The fact that the city of Berlin has for sometime used no other electric street illumination than flaming arcs,—some five thousand being in service; that other German cities are installing them as rapidly as possible; that they have been recommended as the result of a special investigation on the subject of street lighting for use in the principal thoroughfares in London, is beginning to make some impression upon those responsible for street lighting in this country; and although the remarkable fact remains that there is not as yet a single installation for this purpose in the United States today, there are a number of cities which have the matter under careful consideration.

The characteristics of the flaming arc which recommend it to consideration are its enormously high efficiency,—from six to eight times that of the carbon arc,—its very much lower intrinsic brilliancy (which means freedom from glare), and a better color of light. The two offsetting disadvantages are the necessity for more frequent trimming, and a natural distribution which is theoretically less advantageous than that of the common form of arc lamp in use today.

It is not impossible that the first of these may be entirely overcome; in fact, a lamp of this type which has a long life and high efficiency appeared some months ago in England. The second defect is perhaps more theoretical than practical, and can be overcome to a considerable degree by placing the lamps at a suitable height, which may be two or three times that in the present arc lamp practice. In streets that are free from the obstruction of trees,—a condition which exists in all busy thoroughfares,—the placing of the lamps higher is a decided advantage, as it removes them further from the line of vision. If the distribution curves of the ordinary arc and the flaming arc be compared, *drawn to the same scale,* the *form* of the flaming arc curve will be less conspicuous than the long distance of every part of it from the carbon arc curve. In other words, although it does not give its greatest intensity at 50 or 60 degrees from the vertical (which is considered the theoretical condition for street lighting), its intensity at that angle is actually several times that of the carbon arc.

The flaming arc has another characteristic which should not be lost sight of in its practical use in street lighting, and that is its actually large volume of light. The old "2,000 candle-power arc lamp," which was a mere fiction, but which found its way into, and doubtless still remains in many street lighting contracts, can be even surpassed 50 per cent. by the flaming arc, and that, too, in actual spherical and candle-power, or light-flux.

In view of its high light-power, it is manifest that the flaming arc should never be installed in pairs, as is frequently done with the carbon arc where especially brilliant illumination is desired: the fact that a single flaming arc will give twice the volume of light of a pair of carbon arcs leaves no room for argument on this point.

American manufacturers, for some inexplicable reason, allowed the importers to take the American market by default. Fortunately for the consumers, however, the imported lamps have been of most excellent workmanship and quality, and have given highly satisfactory service. How much longer they will dominate the market remains to be seen; but three years of successful operation is no small advantage in the contest for public patronage.

Undoubtedly the most notable movement in the field of illumination at the present time is that for better street lighting, and in no other field is there so much room and need for improvement. Those who have this matter in charge will fail in their duties if they neglect to give the flaming arc lamp careful consideration.

## Eye Fatigue and General Illumination

In his lecture on "Illumination and Illuminating Engineering" to the last meeting of the New York section of the Illuminating Engineering Society, Dr. Steinmetz brought out with his usual clearness and strength the importance of a matter to which we have more than once called attention in previous issues, namely, the necessity of keeping the general illumination as low as possible in all cases where special illumination is used for actual work. The theory was advanced in a paper read before the Society, if we are not mistaken, that where special illumination is used it is advisable to maintain a general illumination of a comparatively high brilliancy, in order that the eye, in turning from special to the general illumination, should not have to undergo the muscular strain incident to adjustment of the iris. That this theory is unsound is made sufficiently clear by simply trying the experiment. The restful feeling of encountering comparative darkness when the eye looks away from the specially illuminated object is at once strongly marked.

A consideration of the action of the eye would likewise show the incorrectness of the theory. The condition of full opening of the iris, and focusing on a near object is a condition of strain; while looking into space without focusing on any particular object, and without encountering brightly illuminated or luminous surface, is relaxation for the eye.

These facts prove without question that not only should the general illumination be kept at the lowest possible intensity in cases where special illumination is used, but that such an arrangement is far better, so far as the eye is concerned, than a general illumination of sufficient brilliancy for the close eye-work to be done. The latter method gives no possible opportunity for the eye to relax as in the former case.

Wherever the objects upon which the eye must focus are within a small space, special or local illumination is undoubtedly the best than can be provided. Offices, libraries, and all industrial works in which the operators work at small machines, are the important cases coming under this category. Whether special or general illumination is the best practice in cases of this kind has been a matter of difference to some extent among illuminating engineers; both experience and theory, however, demonstrate the superiority of using special rather than general illumination.

## The Subdivision of Illuminating Engineering

It is only a couple of years ago that illuminating engineering was an almost unknown term; those who heard it wondered what it meant, and those who understood what it meant wondered that there was sufficient special knowledge required to justify such a new branch of engineering. And yet so rapid is scientific progress in this country that already the subject has begun to subdivide itself. There was recently held in Chicago a convention of the Association of Car Lighting Engineers. As the name implies, this association is made up of those who have direct and in-

direct charge of railroad car lighting. This manifestly is a subdivision of the general science of illuminating engineering, and shows in a most convincing manner the unlimited tendency to specialize which is the chief characteristic of our present civilization. To still further subdivide, the convention considered only methods of electric car lighting, leaving out of the discussion the two other important methods, namely, by compressed oil-gas, and acetylene.

Street lighting is unquestionably a field of sufficient size, importance, and peculiarities of conditions to constitute another special branch of the general subject. Spectacular lighting, including signs and scenic effects, is still another field in which there is room for specialization. Truly, "the world do move."

## The Effect of the New High Efficiency Lamps on Fixtures and Accessories

Along with the tungsten lamp has come the scientific reflector and the scientific fixture. Whether or not the extent to which science is embodied in the construction of this apparatus has been over-rated or not is beside the present discussion; the important fact remains that, with the improvements in electric lamps, has come a realization of the incongruities and absurdities that have for years passed muster among lighting fixtures. The old idea of considering lamp, fixture, and glassware as three entirely different and separate elements of the illuminating unit is fast disappearing, and in its place has come an appreciation of the fact that not only for the sake of efficiency, but even more for the sake of artistic considerations, must a lighting fixture, including the three essentials of light-source, accessory, and support, be treated as a single unit.

The tungsten lamp is going to make scrap of a large number of lighting fixtures and "shades" that have grown old and antiquated in the service of the gas flame and carbon filament lamp.

## Gas As a Domestic Illuminant

While electricity has permanently driven out gas as an illuminant from large commercial buildings, gas illumination still maintains its supremacy for domestic use. The reason for this division lies principally in the conditions of supply of the illuminant, rather than in any questions of superiority of the illumination produced. In commercial buildings heat and power are as important necessities as light, the former even more so. The generation of electric current may be considered in a way a by-product of the heating; the mere matter of cost, therefore, which in other cases gives gas the lead, does not maintain in the case of the large private electric light installations, and even where the current is supplied from an outside source, the convenience of having it on hand for elevator and other power purposes, and the readiness with which the electric conduits can be run, give electricity undoubted advantages over gas.

On the other hand, for domestic use, the small quantity of current consumed, and the very irregular use of it for lighting purposes necessitates the householder being charged the highest retail price, which renders electric light far more expensive than gas illumination. Furthermore, gas at its present price is coming into very general use for cooking and heating, and its combined use for heat and light makes the householder the principal customer of the gas company, and therefore entitled to the most favorable rates. With the comparatively few light-sources required in the dwelling house the question of convenience is of correspondingly small moment. The recent improvements in the shape of inverted burners and more artistic accessories also have kept it fairly on a par with electric light in respect to appearance.

In quality of illumination, there is actually nothing to choose between the two. A perfectly white light is entirely unnecessary in the home; in fact, it is not uncommon to use tinted globes to give additional warmth and color.

The argument of "vitiation of the air," which is still heard abroad, has long since ceased to attract any attention in this country, and with the ordinary means of ventilation provided, can be entirely neglected. In the homes of the "masses" of city dwellers, therefore, gas illumination is likely to hold its supremacy for a long time to come.

# Correspondence

### From Our Baltimore Correspondent

One of the most noticeable features of progressiveness in Baltimore since the fire of 1904 is evidenced in the municipal and mercantile lighting conditions. The merchants especially have been quick to note improvement in lighting units, have relegated to the background the old style illuminants and are substituting instead modern systems of store lighting.

The best illustration of this marvelous change can be found along Baltimore street, the principal business thoroughfare. Where once carbon lamps held sway, tungstens now take the place of honor, and it is difficult to find along a distance of ten blocks, consisting mainly of retail and wholesale stores, a building in which some of these lamps are not in use. These new installations can be attributed chiefly to the energetic hustling and activity of the electrical contractors and supply dealers, some of whom have aggressive, wide-awake solicitors on the street advocating the use of these new lamps, explaining in detail to the consumer the saving in current, the increase in illumination and the general esthetic effect. When once interested the merchants have been quick in noting the benefits to be derived, and have changed old, wasteful installations into new, bright equipments, which, although not so elaborate, are far superior from an illumination point of view.

The merchants on Baltimore street have for some time advocated the installation of more lights on this prominent thoroughfare, and the superintendent of lighting, Mr. Robert J. McCuen, has recently completed the erection of seventy-two double arc lamps in a distance of ten blocks, from Eutaw to Gay streets. These new lamps have met with great favor by the business community, and the citizens are highly pleased with the increased illumination, which, combined with the brilliancy of the stores, transforms the entire street into a veritable fairyland of light.

Light street is in the steamboat district, where nightly during the summer large crowds return from the various bay resorts and travelers arrive by boat from Philadelphia and other cities. In the center of this street, which has recently been widened, aisles of safety have been placed, each surmounted by a double arc lamp.

The awarding of the contract by the Board of Awards of Baltimore City, for equipping and maintaining the gas lighting system, was the subject of a lengthy and somewhat complicated discussion between the members of the board, the repsentatives of the various companies and their attorneys.

The contract was awarded to the American Lighting Company, on a one-year basis, for the sum of $105,289.10. This company has had the contract for a number of years and has given the city excellent service. The opinion of the various members of the board differed considerably as to the advisability of awarding the contract to the American company on a one-year basis, or to the Sunlight company on a three-year basis, and it very probably would have awarded the contract to the latter concern on this basis, which was much lower, if objections had not been filed.

To encourage competition the board advertised for bids on a one, two and three-year basis, and it was the general feeling among the members that it has only been through competition that the prices for maintenance have been so far reduced. What has more than anything else caused the lack of competition in the lighting bids of Baltimore is the fact that the city has in the past awarded the contract on a one-year basis, which gives the holder of

the contract a decided advantage, in that no new concern is in a position to successfully compete on a short term contract against a company holding the contract with plant already established.

The Attorney-General of the state and the former City Solicitor represented the American Lighting Company, and it was alleged that thirty tests were required before the burner of the Sunlight company came up to the specifications, and it was also proven by a letter from the City Photometrician to the Superinttendent of Lighting that the Sunlight Company had refused to submit the original burner for test that had been submitted with its bid and had substituted other burners instead.

In view of these conditions Superintendent of Lighting McCuen made no recommendation, simply submitting the figures for tabulation and allowing the board to arrive at its own conclusion.

It was contended by the attorney of the Sunlight company that the award was not fairly made, that competition was discouraged by awarding contracts on a one-year basis, and he also submitted facts to show the responsibility of his concern. The board decided that, although there would have been a saving on the three-year basis, it might have proven costlier in the end. It is believed, however, that by giving the contract to the present holder, sooner or later the city will find itself in the grasp of one concern, and there will be no possible way to attract new companies to submit bids.

The board also awarded the contract for the purchase of 1,500 boulevard gas lanterns to the Cleveland Street Lighting Company.

The American Lighting Company fought the purchase of these lamps by the city, on the ground that it had offered to furnish the boulevard equipment in place of the worn out Miner lamps on condition that the ownership of the lamps remain with the company. The Board of Award, however, approved the specifications on the ground that the city, by owning its entire equipment, as well as its Miner outfit, could prevent monopoly in the lighting contracts. The price bid by the Cleveland company was $4.75 per lamp.

Sydney C. Blumenthal.

Baltimore, December, 1908.

Chicago, December 7, 1908.

The Illuminating Engineer.

Dear Sirs: In the November issue of The Illuminating Engineer I notice an article entitled "Diagnosis Under Artificial Light," by Mr. F. W. L. Peebles. It seems rather strange that professional men as a rule are seemingly timid in adopting modern methods. I cannot understand how the coloring of ordinary electric light bulbs can be called progressive when one might have a Moore tube, in one of its many forms, fulfilling practically all of the requirements of daylight.

It is one of the problems that has yet to be solved why progressive professional men will not take the initiative in this country. I have had innumerable inquiries in reference to this subject of operating lights, and only recently, in the paper which I read before the American Hospital Association at Toronto, Canada, on "Hospital Construction," I advocated the use of the Moore tube, stating that "the ideal light for operating rooms has thus far never been used to my knowledge, namely, the system of rarified gas, electrified, in tubes of one form or another, from which a white light can be obtained that has a low intrinsic brilliancy, but gives an extremely brilliant illumination."

The Moore Tube, which is a continuous tube running around the entire room, and which can be put up in a manner that is ornamental besides being useful as a light, has solved the problem of color distortion. From this tube can be obtained light either of pure white, or sunlight color, or any varying degree between. Why it has not been used in hospital operating rooms is one of the questions which cannot be answered here. It is probably due to the fact that it is new, and operators, as a rule, prefer to stick to the old method of having the hot, unsightly cluster of incandescent lamps over the table so they can swing the fixture.

It might be said that what is true for operative work is also true for the necessary light for diagnosis. The various portable or unit forms of the Moore Tube which have been designed are admirable for this purpose. There is one in particular which takes a form resembling an arc lamp, which might be used in preference

to any other form of lighting which has been devised over the operating table.

According to the makers, it operates at 220 volts, and requires 25 watts, yet gives 25 per cent. more useful illumination than an enclosed arc. The fact that it has a low intrinsic brilliancy, and can be run in such form that there are practically no shadows thrown, as with the old form of cluster incandescent lamps, and the added fact that it can be operated at a less cost and gives higher lighting value, should recommend it at once.

The question arises immediately in the minds of hospital authorities, "How much does it cost?" and, despite the fact that the initial cost would be more than made up in a short time by the saving in operating expense of the light, this seems to have had no bearing whatever, and, in consequence, it has never been used for the purpose of operation or diagnostic work.

Yours respectfully,

MEYER J. STURM.

## Which Is Easiest To Read ?

The Editor of THE ILLUMINATING ENGINEER, New York.

Sir: The recent contribution to your columns anent this interesting theme has aroused some little attention on this side of the Atlantic, and as a matter of fact, appears to have been anticipated by us when, in designing a poster for the now closed Franco-British Exhibition, which would prove to be strikingly effective and novel, we tried the experiment of white lettering on a black background, the said trial being eminently satisfactory.

We conceived the notion that the peculiar conditions which characterize the lighting of the London Tube railways called for something out of the ordinary in poster production, and the enclosed specimen was the result. The announcement has attracted far more notice than we might have expected, and our firm conviction is, that although this is probably by no means the last word on the subject of Tube Advertising, the idea of an attractive advertisement in the necessarily garish albeit subdued light of our subterranean railways is certainly met by the whitest of white letters emboldened by the


blackest of black groundwork.

Yours truly,

DAVIES, TURNER & CO., LIMITED,

HAROLD DAVIES, Chairman.

International Carriers, 52 Lime Street, London, E. C. November 7th, 1908.

NEW YORK, N. Y., Oct. 29, 1908.

Editor of THE ILLUMINATING ENGINEER: 12 West 40th Street, New York.

*Dear Sir:*—Your review of the papers delivered at the Convention of the Illuminating Engineering Society in Philadelphia contains an item referring to my paper on Engineering Problems in Illumination which is apt to convey a wrong idea as to the actual scope of my paper. The latter is not at all of a theoretical nor mathematical nature, as you stated, but is purely descriptive. I was asked by the Committee of Papers to deliver a lecture on the Designs of Reflectors for Uniform Illumination; I, however, preferred to give my paper the present form upon the following consideration.

The most difficult problem which confronts the illuminating engineer, relates to his cooperation with the architect. It is up to the illuminating engineer to

prove that the architect requires his assistance and I hoped to render some kind of service to the illuminating engineer as a whole by demonstrating that there is a vast field of purely technical and engineering activity which has and can only be attended to by the illuminating engineer, thus emphasizing its usefulness and significance. I ventured to remark that the illuminating engineer should not drift into the territory of the architect, because the architect understands this kind of work much better than the illuminating engineer. It was, however, not my intention to proclaim the neglection of esthetics in connection with illuminating engineering. I even feel inclined to believe that we will be able by proper illuminating engineering to gradually develop forms of fixtures and lamps, which being proper from the viewpoint of the illuminating engineer at the same time please the eye of the on-looker. This would be a similar evolution as it has taken place in connection with structural art of any kind. The problems presented in my paper are problems of real illuminating engineering, and they are so numerous and modifiable that they offer plenty of work to many illuminating engineers who do not care to encroach on the territory of the architect. I, of course, do not deny that there might be other problems which can be solved by the illuminating engineer, but this kind of work, as illustrated in my paper, is apt to cover the demands of the architect more than anything else the illuminating engineer can produce.

It was gratifying for me to observe that the only architect who spoke at the Convention exactly verified my ideas and encouraged the illuminating engineers to supply the architect with engineering data in illumination.

Very truly yours,

ALFRED A. WOHLAUER.

NEW YORK, November 6, 1908.

THE ILLUMINATING ENGINEER.

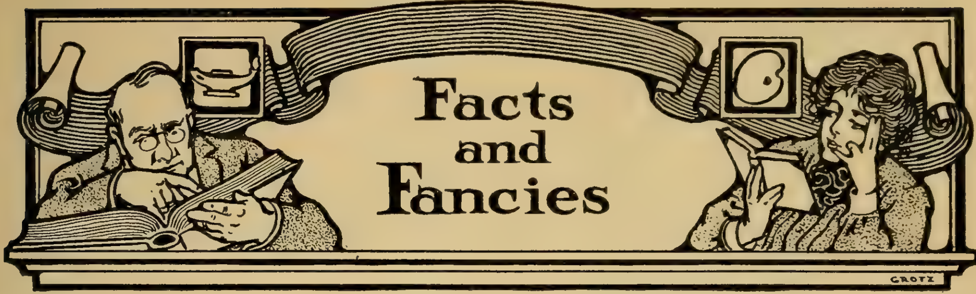
Gentlemen: I have been recently notified that a number of papers throughout the country and in Europe have taken up in a serious vein the theory of using *light tinted* symbols on *dark* backgrounds. These, with but few exceptions, have been all based on the assumption that the theory, as presented through your magazine, was *white* lettering on *black* background, whereas, as you will appreciate, I have advocated not *white* on *black*, but *light tinted* symbols on *dark* background. An illustration of this theory may be noticed by referring to this letterhead, where the "Bureau of Illuminating Engineering" appears in an amber tint against a dark green background.. This combination of tints, from what investigations I have made, seems to be the best, although I am not prepared to state that same is ideal, owing to the fact that my experimental work has not been completed.

I fully appreciate the fact that to use this proposed method on the spur of the moment, without due process of evolution, would be exceedingly confusing and more or less injurious to the eyes; but I am so thoroughly convinced that the present method of *black* on *white* is wrong that until such time as *light tinted* symbols on *dark* background can be put into use I am strongly advocating, and especially for school purposes, that the printing in books be on amber or yellow paper, with mat surfaces, instead of the present white.

From letters which I have had from various sources on this general subject, it looks as if it is only a matter of time when this process will be seriously tried out.

Yours very truly,

A. J. MARSHALL.




# Getting Into Society by Illumination

By Guido D. Janes.

When Flint Shalling went over to Ducktown to reside he thought he would get into society by purchasing a diamond ring for Mrs. Shalling. So he saved up some coin and purchased a caret and a half of the luxury, after which he bestowed it upon the one for whom it was intended. He then packed up his personal property and went over to the said place to reside. But upon his arrival there the inhabitants were found to be of such a conservative nature that they were regular eskimos to him and his domestic circle.

"Too bad," remarked Flint, coming home one evening to their mortgaged residence and greeting his wife with a tear. "I fear we are turned down by the '400,' for the mayor just a few minutes ago treated me like a step child."

GOODNESS, WHERE DID YOU LOSE IT?

"Well, that is not a circumstance to what I have to tell you," said Mrs. Shalling, emphasizing her words with groans. "I have lost the diamond."

"Goodness! Where did you lose it?"

"Don't know. I have hunted for it vehemently quite a long while."

"Did you hunt with illumination?"

"Yes, but you know they only burn kerosene lights here, and they give off about as much light as a speck of soot does at night."

"Well, we must find it. I will wire the house, if necessary, and put in some tungsten burners. The diamond is worth it. We can manufacture our own electricity. If we don't find it we can have something bright around, no matter if *we* are not."

"All right."

So Flint imported some electricians from Knoxtown and had them install a quantity of illumination, also a gas engine to four horsepower, and a pile of volts into the residence. This being done the electricians strolled back to their home town, leaving him in possession of much light.

Then began the search. After ten minutes of meandering over the lighted zones, the luxury was discovered sparkling under a tungsten cluster in the front hall.

Meanwhile the inhabitants thought Flint's residence to be in a conflagrating condition. They were pleased, of course, until they were told it was simply electric brightness. Then began the gossip. Some argued that the Shallings were afraid to go to bed in the dark, while others stoutly

maintained that it was Mrs. Shalling's Montana diamond giving forth sparkles.

"At all events, I shall find out," remarked Mrs. Tubb, the village social leader. So she called.

"I am so glad to see you!" she cried, as

WHAT BEAUTIFUL CHANDELIERS YOU HAVE!

Mrs. Shalling opened the door in answer to a knock. "Welcome to our village."

"Come right in."

"What beautiful chandeliers you have," said the visitor a moment later, after being ushered into the parlor. "Do you burn kerosene?"

"Dear no. It is electricity. You see we are accustomed to this style of lighting and cannot see with the old fashioned."

"O!" replied Mrs. Tubb. "But where do you get your current?"

"Manufacture it here. And, by the way, Mrs. Tubb, I am going to have a reception next week. I want to know the status of matters. Can you give me a list of the charter members and others of good standing in the local social world?"

"With the greatest of pleasure" And there in the parlor, with pencil and paper and under a tungsten, she ushered Mrs. Shalling into Ducktown society. "There you are," she said, finishing the task, "my name leads."

"You will, of course, come?"

"With pleasure. Good day."

"Good day."

"I have the grandest thing to tell you!" cried Mrs. Shalling to Mr. Shalling as soon as her visitor left. And she put him next to what had just transpired.

"So, society comes here next week," said Flint. "Well, I hate to be revengeful; but I can't see an opportunity slip by. I will install three mercury vapor lights in addition to the illumination already in."

"Why?"

"Wait and see. It is a deep laid scheme and may revolutionize both society and kerosene in the corporation."

"Please tell me."

"No, dearie."

So she had to wait until the night of the reception to find out. Then she did catch on—yes, got next, as it were, to his scheme, when the "400" came with their various wearing apparel, and had them criticized under the penetrating light of the new illumination.

Instead of being a reception it was a knocking fest. And by the time nine o'clock came the affair broke up in a riot. Society was rent asunder. Simply because under the old regime, in the rays of the kerosene light, the grease spots on Mrs. Tubb's party gown could not be seen; the botch work on Mrs. Smith's evening dress was not visible in the old time rays, while the excess red paint on Dorothy Hadden's countenance was never before seen. Now her beau and escort got sore and vowed to himself he would drop her at the first opportunity.

After the riot and alleged reception had left, Mrs. Shalling, who had borne up bravely until now, began to quit bearing up, and killed time with the tear. She found fault with her husband's stunt, and said that he has assassinated her socially.

"Now, dearie, don't be too previous," humorously said Mr. Shalling. "Wait until morning; it may turn out differently."

"All right."

So she waited until the next day, when she looked out of the window to see how the inhabitants were getting on.

At first there were no signs of life, but suddenly some humor sauntered into her face when she observed none other than Mrs. Tubb packing up her household effects and leaving the city. Following

closely on the heels of her were a couple of electricians that had been 'phoned for by the mayor. They were from Knoxtown, and came hither to wire a house.

"Didn't I tell you, wife. How is that for a social victory? You are now the leader of the '400.' And all on account of a ring. Long live the tungsten and the mercury vapor lamp! Long live domestic chandeliers and illumination!"

THE KNOCKING FEST.

CASHIER BOOKKEEPER CONTRACTS ADVERTISING

# Commercial Engineering of Illumination

## The Gas Appliance Exposition

JNO. C. D. CLARK, CHAIRMAN.

According to reports the exposition of gas appliances, which was held under the joint direction of the National Commercial Gas Association and the American Gas Institute as an adjunct of the annual convention of the former organization, was decidedly the leading feature of the occasion. Mr. John C. D. Clark, the Commercial Manager of the People's Gas Light and Coke Company, Chicago, was Chairman, and Mr. A. Cressy Morrison, Manager. Seventy-one firms and individuals manufacturing gas appliances were represented. Of this number thirteen—practically 16 per cent.—manufactured or dealt in lighting appliances. Considering the fact that from 60 per cent. to 75 per cent. of illuminating gas used at the present time is for lighting purposes, the discrepancy in the representation of the illuminating interests is rather remarkable. Among the whole seventy-one exhibitors, there was a solitary fixture manufacturer; nine of the exhibitors manufactured or imported gas burners.

A comparison of the exposition with the exhibits connected with the convention of the National Electric Light Association may not be without interest. While the Central Stations probably do not derive more than half their income from lighting, the general impression from the exhibits at the convention would be that it was distinctly an exhibition of electric lighting.

The general character of the Gas Appliance Exposition shows plainly either one of two things; that the manufacturers of gas stoves and heaters are very much more keenly alive to the advantages of a popular exposition and demonstration of their wares than are the makers of lighting devices, or that the gas interests themselves are basing their hopes of future business upon the increased use of gas for heating and cooking, and are letting the lighting end take care of itself. There have been no improvements of any kind in cooking and heating appliances for years past, while gas lighting appliances have been undergoing almost revolutionary improvements within the most recent time; and yet the latter were entirely subsidiary to the former in this presumably representative exposition of the modern uses of gas.

# Practical Illumination

## Some Suggestions for Gas Company Inspectors

By H. Thurston Owens.

Company inspection of gas piping in new buildings is an established feature of the gas business in this country, and as the men doing this work come in direct contact with architects and builders, they can be of great service towards the solution of the problem of better gas illumination.

The past decade has witnessed some wonderful developments in the use of gas for heat and power in addition to light. In a few years increases of sales per capita of from 2,000 to 5,000 cubic feet have not been unusual, and even 10,000 has been exceeded. It did not take long to ascertain the fact that the size of piping which had formerly been sufficient would no longer answer the purpose, and the architects were immediately appealed to to specify pipes of a larger size. Although it was not so stated, the companies desired to sell service and not gas, and the conditions are the same regarding illumination today.

The author has no intention of trespassing upon the good nature of either the reader or the architect by discoursing upon that popular although somewhat profitless discussion as to who is to blame for the fixtures we use, but will confine himself to the question of outlets.

As a rule, gas companies have been content to issue rules regarding the size of pipes; but why should they stop there? You may run pipes all around each room and thereby provide ideal conditions as far as supply is concerned, but what of it if the outlets are located so as to prove almost useless for the purpose of providing good illumination? A plenteous supply through a remodeled distribution system will take the kinks out of your pressure chart, but will leave a few in the mind of your consumer unless he obtains satisfactory illumination. Architects may not take kindly to full fledged consulting illuminating engineers, but they welcome suggestions from the companies.

In the matter of piping for industrial appliances the companies have been very active in furnishing expert assistance, and where this has become a specialty the title of "commercial engineer" has been used, although just what it means is a matter which is open to speculation. The advice freely given has been of great value to both company and consumer, and it is as sorely needed in the field of lighting as it was in heat and power. The types of gas units are comparatively small in number, and their proper use is a matter which the inspectors could ascertain without prolonged study. It is not expected that they be qualified to plan extensive installations, but there are many details which might be classed under the head of "Don'ts," the elimination of which would go a long way toward improving present-day conditions.

DON'TS.

Don't forget the entrance or porch lamp.

Don't forget that the head and foot is the place for stair lights.

Don't fail to provide central outlets in dining rooms, parlors and sitting rooms, and floor outlets in large sitting rooms.

Don't place central outlets in small bedrooms unless you provide one at each side or over the place where dresser will be located.

Don't forget to place an outlet at foot of cellar stairs and at all other convenient points in the cellar.

Don't place central outlets in kitchens unless the equipment will allow lamps to be located near the ceiling.

Don't forget that light is required in the servants' quarters.

The following accessories, if not fundamentals, of illuminating engineering may determine whether the foregoing "don'ts" are correct:

No man will dare say that he "is afraid to go home in the dark" if his porch is well lighted.

He can tip-toe upstairs if they are well lighted.

Central lamps will furnish adequate illumination for special purposes, and if floor outlets are provided the iron piping can be continued direct to the lamp on desk, table, etc., eliminating a very disagreeable, not to say dangerous, feature of gas lighting, namely, the rubber tube.

A man has to shave both sides of his face, and "milady" has to dress her hair all around.

"Hubby" will never grumble about attending to the furnace if he can see to do it; and although light is not so often required in this portion of the house, what's the use of paying the tailor a few dollars to clean soiled clothes when a few cents' worth of illumination will prevent such calamities?

The "czar" of the kitchen will be able to use her sense of sight, as well as touch, smell and taste, for the benefit of the household. At night, in most kitchens, this is the exception rather than the rule. Psychologists tell us that good light will improve her temper and sociologists argue from this that it will enhance her staying qualities also.

The most efficient light source in the servants' quarters will eliminate many worries over large bills, and the best start is made when the outlets are properly provided.

# The Opportunity for Young Men in the Acetylene Industry

By A. Cressy Morrison.

A. CRESSY MORRISON.

The acetylene industry stands today upon the threshold of a great and expanding future. The pioneer work has been done. The chemical and physical characteristics of calcium carbide and acetylene have become known; methods of utilization have been devised which are safe and efficient; public prejudices have been removed. These three things which have held the industry in check are now behind us. We possess two things that are fundamental: the *most* luminous flame, the *hottest* flame. These two things are basic. On either one of them can be built a tremendous industry.

Branching from these two great sources of opportunity are all the allied and subsidiary industries which are an outgrowth of the means of utilization, any one of which contains vast possibilities for the man who will grasp the situation and make the most of it. The progress of the acetylene generator from crude beginnings to safety and perfect mechanism, the educational effort of the past and the success of the illuminant now burned through perfect burners have made an opening for young men which is practically without limit.

While it is true that the acetylene industry stands upon the threshold of a great future, it is equally true that the industry has experienced a rapid and enormous growth. People generally are not aware that fourteen million dollars represents the capital stock interested in the manufacture of calcium carbide alone. There are in the United States fifty-two manufacturers of acetylene generators used for illuminating homes. There have already been placed in homes upwards of one hundred and fifty thousand separate installations. Three hundred towns and

cities in the United States are lighted by acetylene today. The Government of the United States lights some of its most important forts with acetylene. Beacon lights and buoys flash their warnings seaward from hundreds of danger points. Headlights for engines supplied by acetylene are coming into general use. Some of our greatest railroads have adopted acetylene for car illumination. Practically every automobile shows the acetylene flame as the source of that broad path of light which marks its way at night. It is really a great industry today, but, great as it is, it is still in its childhood and youth, in robust health, and with great and unparalleled growth ahead of it.

A good salesman can today command a better salary in the acetylene industry than in almost any other field. Manufacturers of generators are strong enough now to take a good man on a liberal basis, and a year or two experience will put such a man in command of a territory which will produce handsome returns. It is no temporary business. Every generator which is sold aids by making it easier to sell others. There is scarcely a community in which a salesman cannot point with pride to some successful installation, which is the best introduction acetylene can have to the neighborhood.

In the field of the oxy-acetylene blowpipe, the ground has scarcely been scratched. This wonderful pencil of unparalleled thermal energy has at this moment, and not before in this country, reached the point of practical utility where mechanical perfection has met theory. The thorough man who will put enough study into metallurgy and the application of this hottest flame to understand it can, by small beginnings, today, in ten years be in a position to secure an opportunity which means wealth.

Acetylene will, therefore, light a million homes. Great institutions will draw upon this source for their illumination. Towns and villages will glisten with the sunlight sparks of this marvelous illuminant. Lighthouses, beacons and buoys will send far to sea the friendly, warning rays which make a safe path for the mariner. The engineer will light his giant mechanism in a broad, white pathway of light sent far ahead. The yachtsman will dine in luxurious and brilliant surroundings, while the warm rays of his beacon lights protect him.

Acetylene, through the oxy-acetylene blowpipe, will enter every manufacturing institution, whether it be in the city or in the country, whether it be metallurgy, milling or mining; in fact, wherever a broken shaft or cog or a boiler plate needs repair, and throughout the industries of the world. It will be found upon the high seas, not only in the vessels of commerce, but especially on all the war ships of every sea, and ultimately every blacksmith shop must have the hottest flame in the world.

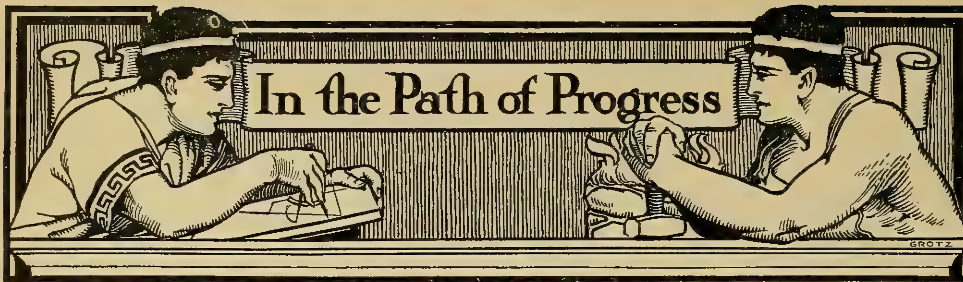
The man who enters the acetylene industry must enter it as he would a profession. No ramification of the industry should be neglected. He should give it the studentship that must be given to law or medicine; he must be philosophical; he must be willing to grow with the industry; he must lay his foundations of knowledge so broad that he will be ready to grasp any new development the moment inventive genius brings it to the surface. It is safe to say that no man of the proper attainments, with the right fiber and quality of mind, could find in any field of enterprise today so many and so great opportunities as will be born of the application of an intelligent mind to the utilization of the best light in the world and the hottest flame in the world. Let them—those who seek opportunity—give consideration to this new but important and remarkably promising industry, for in it lies a straight road to success for any man who will devote himself to it.

## Announcement

Mr. Philander Betts, who for some years has been the advisory engineer for the contract department of the Potomac Electric Power Company, has resigned his position and has opened offices in the Metropolitan Bank Building in Washington, D. C., for the general practice of consulting engineering.

The illumination of the New Masonic Temple in Washington is among his latest work.

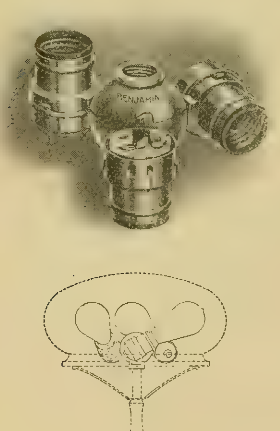
Mr. Betts is a member of the A. I. E. E. and of the Illuminating Engineering Society.




## Ingenious New Electric Fittings

In speaking of Kipling's versatility, a critic once said: What can he do? What can he *not* do? Any one who has followed the development of the Benjamin line of electrical specialties will be very much inclined to apply this same expression to the ingenuity of Mr. R. B. Benjamin, and better still than ingenuity is the fact that his productions are always thoroughly practical. The illustrations below show some of his late devices, consisting of a very clever "wireless cluster," by which the position of the several lamps can be changed at will. Each socket can be turned independently on its central support, thus bringing any lamp into any position, from upright vertical to pendant vertical. The outline sketch shows its usefulness in cases where the lamps are in a confined position, as in a dome or bowl.

Still another useful device is the canopy switch shown below. This is entirely concealed in the ceiling canopy, and operates by a single chain or cord dropped from the side. With this device it is possible to turn out the lamps successively in a cluster, thus removing the only objection ever raised in relation to this much used device—the inability to "turn it down," so to speak.



BENJAMIN ADJUSTABLE SOCKET CLUSTER.

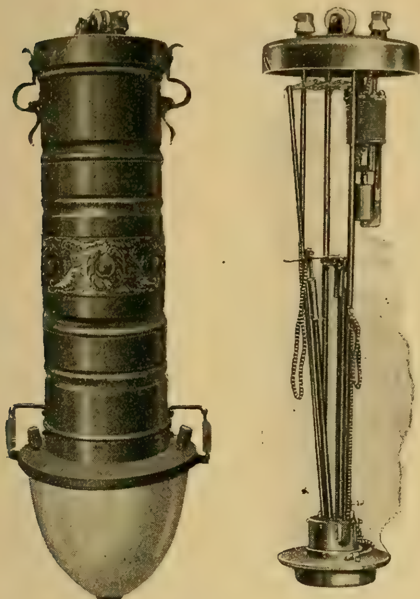
BENJAMIN CANOPY SWITCH.

## Progress of the Flaming Arc Lamp

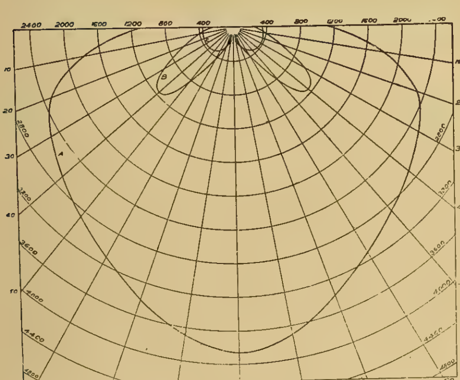
The general advantages of the flaming arc lamp are noted elsewhere in this issue, and also the rather curious fact that American manufacturers have been slow to take up the matter of constructing a lamp of this kind. This apparent delay, however, may very likely be simply the result of a desire to produce something better than the imported lamps, or, at least, something better adapted to American conditions and practice.

Dr. Haweis, an English writer of note, once set forth the following epigram: "Some men are remarkable for the things they do, and some things are remarkable for the men that do them." The "Victor" flaming arc lamp must certainly fall under one of these categories: it is put out by the Western Electric Company. Aside from this title to distinction, it is of de-

cidedly novel construction. The following description and illustrations are taken from the company's bulletin:



"VICTOR" FLAMING ARC LAMP AND MECHANISM.



PHOTOMETRIC DISTRIBUTION CURVE OF VICTOR FLAMING ARC LAMP.

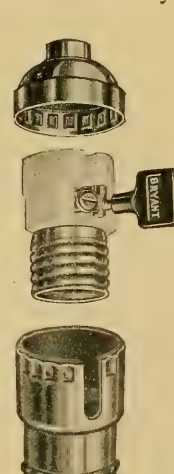
The lamp has a frame of the parallel rod type which we have used for many years with great satisfaction in many types of lamps. It will stand rough handling in transportation and installation without serious injury. It holds the parts securely in position and gives perfect alignment. It is composed of but four pieces, the iron top, two brass guide rods and the bronze base.

Cases are of copper polished or of steel japanned finish, and are of substantial construction. They are easily removed and when taken off give complete access to all parts of the lamp. This enables the attendant to examine all parts at any time without taking the lamp down. All parts used in the lamp are formed and mounted with special reference to facility of repair or replacement, are of the very best material and accurate in size and workmanship.

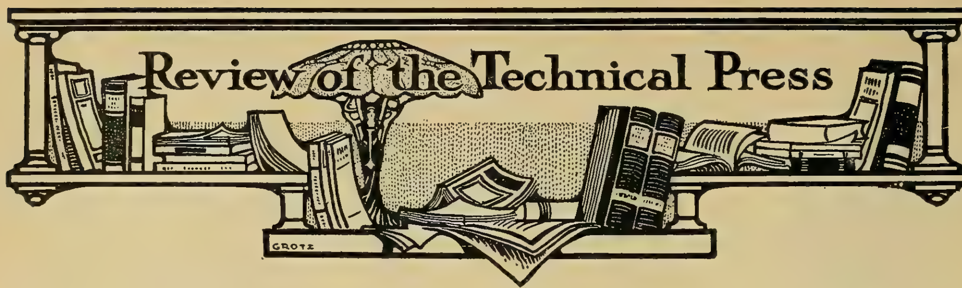
The Paraboloid globe adopted in this lamp is a new departure in lamps of this type. It is found to give most excellent results, improving the diffusion of light, presenting a large uniform area of illumination, and reducing globe breakage.

## The Latest "Wrinkle" in Sockets

Our readers are already familiar with the "new wrinkle" in electric sockets, which consists of an improved mechanical construction by which the shell is held very much more firmly to the cap than by the old method, and which also has the very desirable feature of allowing the key to be placed in any desired position after the cap has been screwed home. The latest improvement of this new "wrinkle" is a construction which covers up the indentations, or wrinkles, about the top of the shell, thus giving the socket a finished appearance without interfering with its mechanical advantages. It would seem that, with this finishing touch, the socket is as near perfect in simplicity, strength, and appearance as it is possible for human ingenuity to construct. This socket is the product of the Bryant Electric Company.




IMPROVED "NEW WRINKLE" SOCKET.




# American Items

## Book Review

Electrical Illuminating Engineering, by William Edward Barrows, Jr., McGraw Publishing Company, New York. 216 pp. $2.00 net.

Mr. Barrows is assistant professor of electrical engineering in the Armour Institute of Technology, Chicago, and the present book is made up of the collected and extended notes of former lecture courses given in the Institute. It is distinctly a class room text-book. The subject is divided into the following chapters:—

Light and Color; Units of Illumination and Photometry; Photometry and Photometers; Spherical Photometry and Integrating Photometers; Standards of Illuminating Power; Incandescent Lamps; Arc Lamps; Flaming Arc Lamps; Vapor Lamps; Shades and Reflectors; Illumination Calculations.

Naturally the book contains no absolutely new material, its value resulting from the collection into a single small volume of the essential theoretical data pertaining to the subject. There is no attempt at simplifying or "popularizing" the subject, free use of the higher mathematics being made in all cases where the theory of the subject is susceptible of mathematical treatment.

In some cases it would seem that the author has followed his source of information too rigidly, and thereby run counter to the present usage in practical work; thus he says "The unit of illumination is the meter candle. * * * Illumination is occasionally expressed in foot-candles." This is certainly an absolute reversal of American practice, and is likely to continue so until the metric system comes into general use—a condition which is not yet in sight. He also uses the very peculiar term "lumen-candle," which he says is the "unit of flux," and then defines it by the definition which applies to lumen.

Again, in the chapter on "Photometry and Photometers" he says: "Photometers may be classified in two general types; first, those depending upon visual acuity, and known as *illuminometers,* which measure the light by the ability of the eye to detect objects illuminated by it," etc. This statement is not only incorrect, but most unfortunate, as it tends to give authority to, and spread the use of the error, and thus add to the confusion of terms which is already a serious handicap to the progress of the science. The only instrument of the kind is one designed by Mr. Ryan for his own private use, and which has never been placed upon the market or become generally known, Mr. Ryan himself fully recognizing its limitations; and even this was not called an "illuminometer," but a "luminometer." Later on the author contradicts his own definition by describing the "Marshall illuminometer," which is an instrument in which the measurements are made by bringing the intensities of illuminated surface to an equality. The term illuminometer has become fairly well established as applying to that class of portable photometers especially constructed for measuring general illumination. The term is absolutely consistent and suggestive of its meaning, and forms a desirable addition to the nomenclature of the subject, and should not have its meaning distorted to suit individual tastes.

As a class drill book, and to those who are at home with the higher mathematics and accustomed to think in mathematical terms, the book is of undoubted value, and as such supplies a place that has hitherto been unfilled.

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The November number of *Selling Electricity* is devoted especially to the Tungsten Lamp, and contains the following contributions:

Welding the Tungsten Filament, by S.

E. Doane; Smaller Bills at Higher Rates, by William S. Kilmer; Tungsten Row (Bennington, Vt.), by Frank B. Rae, Jr.; Tungsten Lamps in Waterville, Me., by W. S. Wyman; Introducing Tungsten Lamps into Minneapolis, by H. J. Gille; The Use of Reflectors, by W. J. Cady; Successful Renewing Schemes, by L. D. Mathues; Tungsten Lamp Usage, by Albert J. Marshall; A Sectional Display Booth, by F. S. Root; What the Rating of an Incandescent Lamp Really Means, by T. W. Rolph; Tungsten—"The Electric Welsbach," by H. Thurston Owens; Tungsten Lamp Clusters for Store Lighting, by John G. Larned; Fighting Gas with Tungstens in Brooklyn: An Interview with M. S. Seelman, Jr.; Indirect Illumination, by A. D. Curtis.

STREET LIGHTING, by Dr. Louis Bell: *The Central Station,* December.

A somewhat comprehensive article on this important subject, in which foreign practices are contrasted with American. Like other of Dr. Bell's writings, it is too succinct to bear being extracted.

STORE ILLUMINATION, by Norman Macbeth: *Dry Goods Economist,* November 28.

The second of Mr. Macbeth's contributions on this subject to this periodical. As in his previous contribution, Mr. Macbeth does not confine himself solely to telling what is good, but points out in a fearless manner the various idiosyncrasies and "tricks of the trade." Neither does he confine himself to "glittering generalities," but gives in detail descriptions and results of actual installations.

GASOLIERS AND ELECTROLIERS, by "R": *American Gas Light Journal,* November 30.

Shows how wooden construction may be adapted to gas fixtures.

THE VALUE OF STREET LIGHTING, by H. T. Owens: *American Gas Light Journal,* November 23.

An illustrated article touching briefly on a number of points in this branch of lighting.

ACETYLENE TOWN PLANTS, by Alton D. Adams: *Municipal Journal and Engineer,* December 2.

Contains a large amount of useful statistics.

THE ABSORPTION-OF-LIGHT METHOD OF CALCULATING ILLUMINATION, by A. S. McEllister: *Electrical World,* November 21.

The writer "believes that a more useful relation is that connected with the *absorption of light* rather than the reflection; that is to say, quite independent of reflection and counter reflection, the lighting units within a room must produce *the sum of the lumens absorbed* by the various surfaces. From this relation one can readily determine the total lumens to be generated in order to produce a certain incident illumination, because from each surface there is a direct ratio between the absorbed and the incident lumens."

LIGHTING OF THE MOORE THEATER AND THE NEW WASHINGTON HOTEL AT SEATTLE, by Louis P. Zimmerman: *Electrical World,* December 5.

An illustrated description of these two installations.

# Foreign Items

COMPILED BY J. S. DOW.

### Illumination and Photometry

Bainville, A., SUR LE DANGER QUI PRESENTMENT LES SOURCES LUMINEUSES À GRAND RENDEMENT (*L' Electricien,* November 7).

Granjon, A., LES EFFETS DE LUMIÈRE ARTIFICIALLE SUR LA VISION (Rev. des *Eclairages,* November 15).

Vogel, O., BLAU ODER ULTRAVIOLET? (*Z. f. B.,* November 10).

These three articles comment upon the subject of the effect of ultra-violet light upon the eye, etc. That by A. Bainville is a resumé of the recent results of Drs. Schanz and Stockhausen, as described before the German Institution of Electrical Engineers. Granjon also discusses the

same work. He regards the suggestion that artificial illuminants in ordinary use ought to be screened with special glass in order to obstruct the passage of ultra-violet light, as uncalled for, but admits that special precautions are necessary in the case of sources that are known to be exceptionally rich in such rays.

Vogel gives an interesting account of the development of sources for therapeutic uses; he contends that it is the blue rather than the ultra-violet region of the spectrum that is physically curative. The latter only irritates the outer surface of the skin and is unable to penetrate to any distance.

Corsepius, N., The Measurement of M, Hemi. Sph. C. P., with the Ulbricht Globe Photometer (*Illuminating Engineer,* London, November).

The author continues the description of his method of applying the globe to the measurement of mean hemispherical candle power of sources, by placing a special vessel so as to obstruct all light in the lower hemisphere.

Trotter, A. P., Illumination, its Distribution and Measurement (Continued) *Illuminating Engineer,* London, November).

The author continues his serial description of different types of photometers. In the present instance, he describes the instruments due to Rumford and Foucoult, and refers to some of the early work of the former.

Bloch, L., Die neusten Fortschritte der Berliner Strassenbeleuchtung und ihr Vergleich mit den bisherigen Beleuchtungsarten, (*J. f. G.,* November 7).

Describes the methods adopted for the illumination of the streets of Berlin by gas and electricity. The introduction of high pressure gas inverted incandescent mantles has greatly improved the condition of the streets lighted by gas, while equal progress has been made in the electrically lighted streets by the introduction of flame arcs, especially a new type yielding a white light and utilizing vertical carbons. The article contains numerous diagrams illustrating the distribution of the illumination in the streets and is also accompanied by a useful table of the results of using the two illuminants. The author, however, states that it is not possible to draw any general conclusion as to the merits of the two illuminants; each individual case calls for special consideration.

Harrison, H. T., The Cost of Street-Illumination (*Illuminating Engineer,* London, November).

A simple account of some of the considerations underlying the calculation of the cost of street-lighting. The author gives some tables illustrating the candle-power and cost per 1,000 hours of different illuminants, and the effect of spacing lamps at certain distances apart, etc.

The Lighting of Buoys and Light-houses and Beacons by Acetylene (*Illuminating Engineer,* London, November).

America and a Unit of Light (J. G. L., November 10).

## Electric Lighting

Bohm, R., Die Vorstufen von Metallfadenlampen (*Elek. Anz.,* November 12).

Duschnitz, B., Metallsiche Leuchtfäden und Metallfadenlampen in der Fabrikation und in der Praxis (*Elek. Anz.,* November 8, November 19).

Eichel, E., Neuerungen der Amerikanischen Beleuchtungstechnik (*Elek. Anz.,* October 22 and 25).

Flesch, M. L., L'Eclairage Electrique (*L'Electricien,* October 31, November 7).

Die neueren Bogenlampen (*Z. f. B.,* October 30, November 10, November 20).

All the above are articles dealing in a general and comprehensive manner with recent developments in electric lighting.

Duschnitz, in the course of his article, mentions one rather curious discovery of the Auer Co. It was found that the filaments of metallic lamps tended to become warped in the course of manufacture, when in the soft condition. Eventually, it was found that this was due to the

action of the earth's field on the filament when carrying a current, and, therefore, in a soft, plastic condition. In order to guard against this effect the company in question have taken out a patent covering methods of neutralizing the effect of the earth's field by surrounding the apparatus with heavy iron material, etc.

THE GERMAN TAX ON GAS AND ELECTRICITY (*Elec. Engineering*, November 19; *Z. f. B.*, October 30; *E. T. Z.*, November 12).

DIE STEUER AUF LEUCHTGAS UND ELEKTRISCHE ENERGIE IN ITALIENE (*Fasolt, E. T. Z.*, November 19).

These two references deal with a matter that has been causing much discussion German Government to put a tax on gas and electricity and illuminating apparatus. A tax of about ½ pfennig per cubic metre of gas, and the same sum per unit of electricity is anticipated, and a charge of 10 pfennigs and upward is to be placed on incandescent mantles and glowlamps, according to the candle power. The tax has given rise to much opposition in the technical press representing gas and electricity, as it is considered that the development of the industry will be hampered; it is also urged that it is undesirable to encourage people to be parsimonious in the use of light.

The article by Fasolt discusses the effect of a similar tax in Italy, which he finds to be unsatisfactory in action and hampering to the growth of the industry, especially as regards cooking and heating by electricity.

DIE FERNSCHALTUNG UND FERNÜBERWACHUNG DER ÖFFENTLICHEN ELEKTRISCHEN BELEUCHTUNG IN BERLIN (*E. T. Z.*, November 5).

INSTALLATIONSMATERIAL FÜR BELEUCHTUNG VON BERGWERKEN (*Schreiber, E. T. Z.*, November 5).

The author discusses the design of electrical fixtures, lamps, etc., for use in mines. He advocates that all lamps should be surrounded both by a stout glass envelope and by a wire cage.

WIRING FOR 25 VOLTS (*Elec. Engineering*, October 29).

PROGRESS IN ELECTRIC LIGHTING BY METALLIC FILAMENT LAMPS (*Electrician*, November 13).

THE ELECTRIC LIGHT SITUATION, THE FUTURE OF THE FLAME ARC (*Gas World* for November 14 and 21).

## Gas Lighting, Etc.

Haber, F., UEBER DIE BUNSENFLAMME (*Z. f. B.*, November 20).

A study of the action of the Bunsen flame with reference to its use with incandescing material.

Schilling, E., BERICHT DER KOMMISSION FÜR DIE GASBELEUCHTUNG VON WARENHAUSERN (*J. f. G.*, October 31).

Schmann, ERGEBNISSE VON BELEUCHTUNGSWESEN (*J. f. G.*, October 24).

Describes the results of some tests of the illumination by gas lighting in the streets of Munich. The author also gives some particulars of the illumination in schools lighted by inverted gas lights. He states that "semi-diffusing" illumination is desirable and preferable to relying entirely on the light reflected from whitewashed ceilings because the illumination from the latter soon deteriorates owing to the deposition of dust.

A GERMAN TAX ON LIGHT (*G. W.*, October 31, November 7; *J. G. L.*, October 27, November 3, November 10; *J. f. G.*, October 24, October 31; November 7, November 14).

The number of references to this matter will suffice to show that the gas press is taking as much interest in the proposed system of taxation as the electrical journals.

THE BAMAG DISTANCE GAS-LIGHTER (*G. W.*, November 14).

SELF-LIGHTING INCANDESCENT MANTLES (*G. W.*, November 21).

GAS AT THE FRANCO-BRITISH EXHIBITION (*J. G. L.*, November 3).

NEW OUTDOOR LAMPS (*J. G. L.*, November 17).

UNVERASCHTER INVERTGLUHSTRUMPF (*Z. f. B.*, November 10).

BELEUCHTUNG MIT FLUSSIGEN LEUCHTMATERIALEN, ETC. (*Z. f. B.*, November 20).

# Miscellaneous News

SAN FRANCISCO, CAL.—The lighting committee of the Merchants' Association, after a thorough inspection of the different sections of the city relative to the needs of the districts for adequate street lights, has been authorized by the board of directors of the association to prepare a plan for a system of lighting it recommends, together with a map of the city, on which shall be indicated the number and kind of lights and the location recommended. The map is to serve the supervisors as a guide where street lights are mostly needed whenever the city's funds will permit of installing lights in the sections which are now neglected. The work is planned by a competent lighting engineer. The map will also indicate the locations and business streets in which ornamental lamps are to be installed if the merchants and property owners will supply the ornamental poles.

ESCANABA, MICH.—Escanaba reports a profit of $18,000 from its municipal lighting plant for the last fiscal year, and it serves consumers at rates less than those charged by the private corporation which formerly supplied electricity to the city. The explanation, of course, is that the private corporation would not have been content with $18,000 profit.

SYRACUSE, N. Y.—For the purpose of improving the appearance of the business and shopping district, as well as providing every protection against accident from faulty insulation, Commissioner of Public Safety Harlow C. Clark is preparing for the removal of a number of wooden poles in that section now used by the Syracuse Lighting Company for its wires. The plan he has mapped out contemplates the removal of all wooden poles in the downtown district where the company carries its wires through underground conduits, these to be replaced with iron poles from which will be suspended the arc lamps. These iron poles are to be of the shape known as the "gooseneck," and will each support one arc.

NEW YORK.—A new system of illumination is being installed along Riverside Drive and in Riverside Park, which is declared to be a great improvement over the old method of naphtha lighting. Other important road and driveways and thoroughfares will be lighted by the new system, known as the Tungsten. It has been tested by the city officials and found to be desirable for highway illumination.

BANGOR, ME.—Bangor now has 450 street lights to illuminate the highways and byways of the town after dark, and of the whole number 150 are tungstens, one-third of the whole number. There are yet a few of the old carbon filament lights in use in this city, as they are still doing good service, and the city electrician believes that it is economy to let them burn out rather than replace them while they are still good. The tungstens that are used by the city in street lighting are 60 candlepower.

EASTON, PA.—The Easton Gas and Electric Company is about to purchase a very large movable, spectacular electric sign and place it in a conspicuous location. Besides erecting the word "Easton," the company wishes to add a short inscription. It wants the people to suggest a fitting expression—a slogan or watchword to add to this sign Some say make it read "Easton 100,000 in 1910"; others say "Come to Easton." Detroit's motto is "In Detroit, life is worth living." Scranton says "Watch Scranton Grow." Denver says "Boost for the city of lights." This sign is to be erected and paid for by the company. It is to burn from dusk to midnight, every night in the year. The company asks the "get together cooperation" of the people to suggest a slogan and mail it to the company—the more the better. A committee of Easton's representative business men will decide upon which is the most effective slogan.

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# *Light and Truth*

*"In vino veritas," runs the old proverb—"in wine there is truth." In luci veritas expresses equal truth in nobler form—in light there is truth.*

*There are few words in the English language whose literal and metaphorical meanings are so nearly akin. To have light on a subject is to have the truth concerning it, and to illuminate a physical object with physical rays of light is to bring out its true physical existence—its material truth.*

*The importance of this fact, and the value of the association of the two ideas, is something to which every merchant should give thoughtful consideration. A brilliantly lighted store carries with it the positive, though unconscious conviction of honesty and fair dealing. Where there is light there is manifestly no desire to conceal. Merchandise that is displayed in the full rays of the modern light-source is literally exposed to the light of truth.*

*Sincerity is expressed far better in actions than in words. The invitation to "look for yourself" which is vividly written wherever a brilliant light shines is a more potent guarantee of sincerity and honesty of purpose than all protestations of word or pen.*

*Just as surely as you walk with caution in dark or dimly lighted places, so you buy with caution in the dimly lighted store.*

*Some merchants, recognizing this general truth, have used "the daylight store" as an advertisement: with modern illuminants there is no excuse for any store not being a "daylight store."*

*An ample and generous use of light is a many-sided virtue; it attracts the purchaser by its air of hospitality, wins his confidence by its manifestation of sincerity, and satisfies his sense of justice and fairness by its searching revelation of the truth.*

*Let there be* MORE *light!*

E. L. Elliott.

STREET IN TOMSK—THE ELECTRIC LIGHT HAS SUCCEEDED THE OLD KEROSENE LAMP.

# Illumination in Cibiria ("Siberia")

## And as a Market for American Lighting Supplies

By L. Lodian.

An occasional foreign article on illumination in other out-of-the-way countries of the globe, cannot fail to interest. To make it, at the same time, of commercial value to the trade—as showing possible markets for their goods—more than doubles this interest. Hence the present paper.

* * *

The proper, official, and native spelling of this vast northern portion of Asia, is Cibiria (from Russ. Cibipia), and that spelling has been adhered to throughout this paper—in accord with our own Washington Board-of-Geografic-Names' recommendation to spell topographic and geographic names, so far as practicable, in the native vernacular. Of course, the reader is free to spell as he pleases: I am only telling him the right way. The incorrect "Siberia" is an ignorant aping of the French corruption "Sibérie." The Gallics are notorious for polluting anything from morals to names.

Cibiria is a region which has completely escaped the gas age. Gas-lighting has never been known there. A quarter-century ago, when there was some notion of installing gas retorts in a few Cibirian towns, the news began to appear in the local papers of the successful operation of central stations in Europe and America. Then the thought was, "might as well try the new light, if trying any." So, after a few years, the machinery was laboriously imported thousands of miles from Teutonia and France and Helvetia, via the Ural Mountains. Much of it took over one year of transport to reach the towns of eastern Cibiria. The municipalities in each case shouldered the cost, as no private individuals would take the risk.

The first lighting was arc-lighting for the streets. Then bulbs were put into some of the public buildings, the opera and other edifices; finally, many private residences installed lamps and took current liberally, sc

CHURCH CAR ON TRANS-CIBIRIAN RAILWAY.

that the town-owned centrals became paying properties.

Along with this progress, came the isolated plants—commercial firms at Ipkytck (pronounced Irkutçk), Tomçk, Bladiboçtok, Xabapobck (pronounced Kabadobçk), Enecei (and half-dozen other word-splitting towns) installing their own private plant, but not furnishing current to outsiders. Most of these I saw over a decade ago—and model little plants they appeared, too.

The fuel used is, or was then, wood; today, oil may be used, as the tank-cars now run through from Batym, South Russia, to all points on the trans-Cibirian—long, 5000 to 7000 mile trips. There is no coal. Cibiria has vast water-power available, but nobody so far has cared to venture the initial heavy outlay to utilize it for light and power.

"Home-made" vapor gas for the gasoline lamps (table and store use) is confined to many of the homes of the natives in the towns—and this was the beginning of the mantle in Cibiria. The danger of these gasoline lights, however, led to the adoption of the French kerosene-incandescent lamps—using (after a little heating) the ordinary oil.

Street-lighting in Cibiria is a combination of the "sublime and the ridiculous"—the arc-light towering above the homely oil-lamp in its lantern on a wooden stump.

In the villages, oil and home-made tallow-dips are the illuminants. The purity of those dips may be judged from this, that I have seen the Cibirski housewife, when wishing to enrich the soup, drop three or four of the candles into the steaming soup-tureen—wicks and all—in full view of everybody at table; give the contents a few stirs, and en suite ladle the savory *chi* into the plates of the guests. This is as natural an incident as if 'twere an American housewife adding a little more salt to the soup. Izbochiks (cabmen) on some of the town streets you may occasionally see, while waiting around, taking the candle from one of their lamps, and nibbling it from one hand, while munching a chunk of brown bread held in the other.

If having no fat for making dips, the Cibirian leaves the giant stove-door open for nocturnal illumination; or may stick a pine-knot into some crevice in the timber walls, and thus fill the place with noxious fumes and smutty particles. If having the choice of that "light," or darkness, I would prefer the latter always. A more disagreeable illuminant than the pine-knot it would be hard to invent.

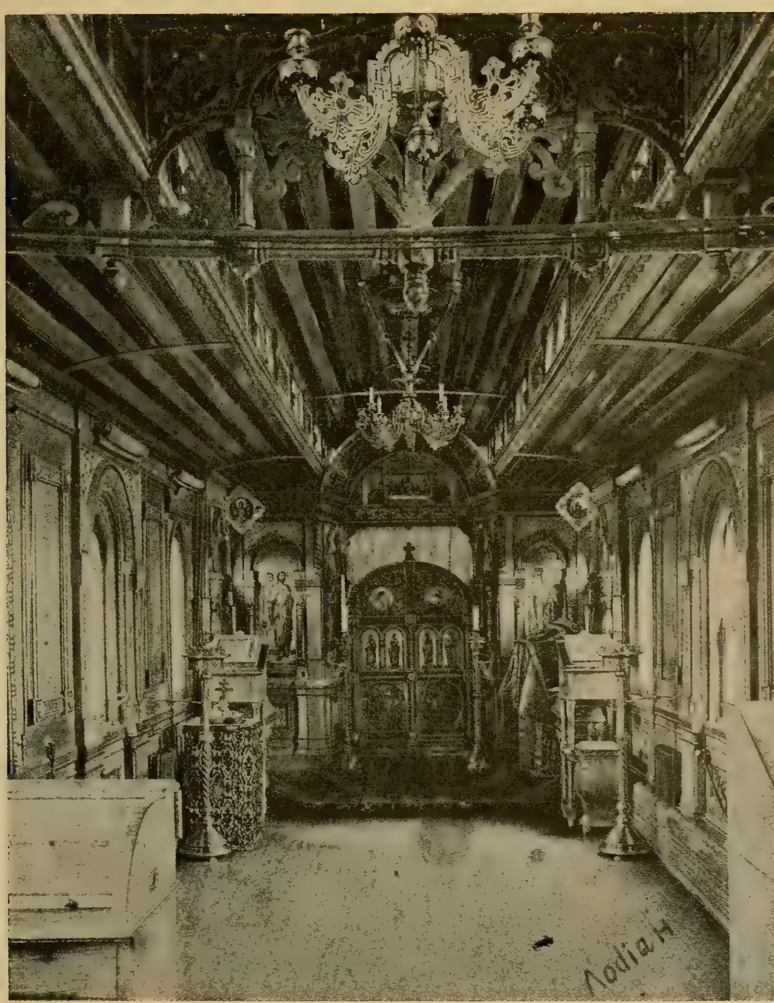
There is not a single firm in Cibiria making a specialty of lighting fixtures, supplies, accessories, etc. The local hardware people

and general importers have met the Cibiriaks' need so far. Such, at least, was the status a decade ago; but if there are to-day more than half a dozen small illuminating-supply concerns in the land, it is because Cibiria has "looked up some" since the writer's prolonged tour there over a decade ago. The trans-Cibirian railroad is now opening up the country, and United States illuminating machinery and supplies makers should come in for a share of it. And it is the mission of this single short illustrated article to take a hand therein—or try to.

* * *

The only lighting supplies furnished by America to Cibiria have been a few thousand Rochester lamps. That a big market exists, may be judged by this article and its illustrations.

The Rhinlanders—and the Gallics, too, for that matter—have a habit of counterfeiting the American lamps; removing every trace of original makers' and patentees' names and metal labels; and sending them out as their own "Deutsch-American" goods, but still they are cute enough not to put their own firmname on the article—for a couple of reasons: it might get them into litigious trouble with the original makers; and, is case of breakdown or failure after being in use some time, there is no standing makers' name on the lamp to warn others against purchasing from them—it is convenient, even, to repudiate all knowledge of the goods; and having got




INTERIOR OF CHURCH CAR, ILLUMINATED BY CANDLES.

their money, the sellers don't care, but go on making other victims.

The simple utilization of the postal service, in the sending of your ordinary American catalogues thereby, is the best, as a starter. There is no need to go to any expense getting out a special foreign-language catalogue either for Cibiria or Russia—or any other part of the globe. I know the contrary is often done, but the expense of translation and reprinting is so heavy, as to often result in a heavy loss. Importing firms in all countries have sufficient intelligence and linguistics—either personally, or among one or another of their associates or employés—to get through any catalogue, no matter if in American, Gallic, Teutonic, or Iberic (or from whatever country the catalogue hails).

Of course, illustration of catalogues is a most important factor: It is the nearest approach to a universal "esperanto" (as the latest and most hopeful idea of a world's language has been named). But, there—illuminating and machinery catalogues, American, are usually lavishly illustrated, and no fault can be found with them on that score.

Addresses of Cibirian importers can be obtained from any of the half-dozen international directories making a specialty of listing all the trades of the globe.

To prevent delay occasioned by price-inquiry from a distant market (where no price-statement appears in catalogue), it is well to inclose a separate pricelist, expressed in American currency, just as if intended for domestic inquiries. Some firms are liable to incur needless expense sending out a statement of prices expressed in the currency of the country where the goods are shipped to, but this is sheer wasted effort. Business importers and exporters all the globe over have sufficient knowledge of the world's exchanges to promptly figure out the ratios of dollars and dukats, florins and franks, pesetas and piastres, rubles and koneki, marks and maravedis, onzas and onzarons—especially with the aid of the ever-handy booklet of the moneys of the universe.

There being no reference agencies of the Dun or Bradstreet type in Cibiria and Russia (with the exception of big cities like Mockba and Peterburg), the conditions of trade should be always on a purely cash basis. American firms act wisely in following the lead of British exporting-to-Cibiria concerns, who stipulate for cash on production of shipping documents. The French do the same; but the long-credits of the Teuton merchants have lost some trade to the former—and a good deal of money to the latter: Since the Cibiriak long-creditor is very prone to degenerate into a "never-pay-up'r." I know whereof I speak, having passed a couple of years traversing the vast Russian Asiatic dominions, from the Pacific overland to Polonia. Better let "the other fellow" get the order than give credit to the Slaf importers of Cibiria.

Illuminating machinery and supplies exported to Cibiria have naturally a rough road to travel; packing to suit is in order, therefore. I have seen American packing as received, or in transport, in most all climes, and can pronounce it "all right." Complaints that arise of damaged goods received, are largely due to the handiwork of customs' employés and forwarding agents, who rarely repack, after inspection, as they found things. Consequently on forwarding into the interior, the goods, due to this negligence, are sometimes received in indifferent condition.

To mitigate this evil, various heavy-machinery American exporters send their own man along, who sees to the proper repacking of goods, and accompanies them through to destination. The entire cost of this, with return-journey, is charged, as per arrangement previously made, to the purchaser. When it is represented to him that it would be to his advantage to pay the extra cost of the—as he is termed—guaranteeing-mechanic (who is ever on the lookout to guard against breakage; to see to the proper erection of the machinery; and, before he leaves, to see everything running smoothly), the buyer usually cheerfully accedes to this increased item of cost. The figure is always arranged in advance, as just noted, and often calculated to a nicety. And a pretty stiff increase it is, too, sometimes!

The guarantee-mechanic is often a highly advantageous institution to the exporting firm, since he is usually interested in being keenly on the qui-vive for yet more business for his firm en route, and in the countries visited.

FIG. 1.

FIG. 2.

FIG. 3.

# The Progress of Tungsten Street Lighting in the City of New York

By H. Thurston Owens.

Tungsten lamps have been in use in the City of New York for over a year and now number about 2000, which is only a small item when one considers that the total number of lighting units is in round figures 68,000.

The city consists of five boroughs, Manhattan, the Bronx, Brooklyn, Queens and Richmond, and the lighting is principally done by means of electric arc lamps and mantle gas lamps, although a number of electric incandescent and mantle naphtha lamps are also used. The two latter types have been used in parks and outlying country roads where gas mains have not been extended.

During 1907 a few tungsten lamps were installed in the Borough of Queens, and over 1000 more during 1908; the 50-55-watt series type has been used for the majority of installations, but where the traffic is heavy the 75-85-watt type is used. The equipment consists of pole lines with bracket attached to pole, as shown in Fig. 1, the reflector consisting of white porcelain enameled steel, and the lamp located about 15 ft. high. They have displaced mantle naphtha lamps.

The conditions in the Borough of the Bronx are similar to those in Queens, but the work of installing tungsten lamps was not started until late in the fall, and comparatively few have been installed.

Until recently only electric lamps have been used in the Borough of Richmond, and the lighting has been very unsatisfactory, owing principally to overloaded lines. The arc lamps, which number over 600, were changed from 325 to the 450-watt type, which is the standard wattage in the city, but the incandescent lamps, which number nearly 4000, were of the carbon filament, 90-100-watt type, shown in Fig. 2. Outages due to breakage have been considerable, and the following method was devised to overcome this obstacle: Two lamps were placed upon each bracket, one below the reflector and one above in a wire cage. When the lower lamp goes out the upper one is automatically cut in. The theory is all right, but in practice not a success, as the amount of light given by the upper lamp is a neglible quantity. Recently some 300 mantle gas lamps have been installed, displacing a like number of incandescent electric lamps. The remainder of these lamps are being changed to 50-55-watt tungsten, the equipment being similar to those in the Borough of Queens (Fig. 1).

In the Borough of Manhattan electric incandescent lamps have only been used for special purposes, such as entrance lamps before buildings, signal lamps on bridges, and in one small park. Practically all of the park lighting has been done by mantle naphtha lamps and electric arc lamps. The electric lamps in this borough are supplied by underground service, and are principally multiple D. C. units. The first installation of tungsten lamps was in Riverside Drive Park, replacing mantle naphtha lamps. The posts were supplied by the city and are of the type known as "boulevard." The lanterns were supplied by the electric company, having been specially designed for the purpose for which they are used. The lamps are 75-watt D. C. and, being placed in a pendant position, with the base of the lamp above the bottom of the white porcelain reflector. The enclosing globe is of clear glass and the dome of green colored glass, shown in Fig. 3. All wires are placed underground in flexible lead-sheathed cables. The lamps are connected in such a manner that six or more of them can be controlled from one point.

It is probable that all of the carbon filament incandescent lamps will be changed to tungsten, and also many more of the mantle naphtha lamps, so that New York will then have the largest installation of tungsten lamps in the country, if not in the world.

# Proposed Improvements for the Lighting of Pennsylvania Avenue, Washington

By Walter C. Allen.

Considerable attention is being given to the question of improving the street lighting conditions in the District of Columbia, particularly with reference to the most important of the business and residence streets. In a recent report to the Commissioners of the District of Columbia, I submitted three plans for the improvement of the lighting of Pennsylvania avenue from the Capitol to the Treasury, two of which involve some novel features. This particular stretch of street is in some respects unique among the thoroughfares of the world. It stretches in a straight line from the White House to the Capitol. The avenue is 160 ft. wide, with a roadway 109 ft. Between the two points named there are two large Government buildings, the post office department and the municipal


FIG. I.—ISLE OF SAFETY, MARKET STREET, SAN FRANCISCO.

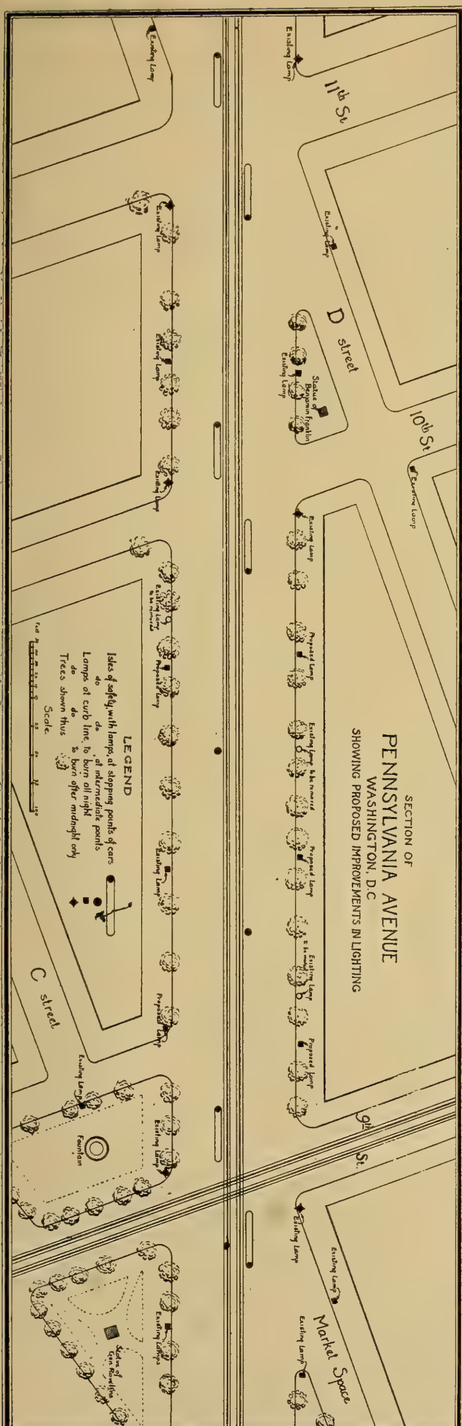



FIG. 2.

building of the city. There are seven triangular parks formed by intersecting streets. In these parks are located statues of Generals Sherman, Hancock, Rawlins, Benjamin Franklin, Governor Shepherd of the District of Columbia and the Peace Monument. The Botanical Gardens, in which the impressive memorial to General Grant is now being erected, is also adjacent. Six large hotels are located within this distance. The avenue is lined on both sides with large sycamore and Oriental plane trees.

The first plan contemplates the construction of isles of safety, approximately 6 ft. wide and 50 ft. long, placed at the regular stopping points of the street cars, on which lamp-posts carrying flame arc lamps will be erected. This brings two isles at opposite sides of each street intersection, and by locating the lamps at the ends of these isles farthest from the center of the intersecting street gives an average separation of 140 feet. When the distance between intersecting streets makes it necessary, intermediate lamps are planned, to be surrounded by circular curbing 6 ft. in diameter. By this arrangement two rows of lamps will be placed down the center portion of the avenue, the lamp spacing being in no case over 180 ft. These lamps are to burn only during the first half of the night, and will be supplemented by direct current multiple enclosed arc lamps placed at the curbs in line with the trees where the shadows from the latter are too dense. The existing corner lamps at the curbs will be extinguished during the first half of the night, but will be lighted when the central lamps are put out.

A suggestion for the design of these isles of safety is found in the type introduced on Market street, San Francisco, some three years ago (see Fig 1). For Washington, it is recommended that the lamp-posts be of a fairly ornamental pattern, purchased and erected by the municipality.

The second plan submitted by Mr. Allen involves the use of magnetite arc lamps instead of the flame arcs, should the cost of the latter be considered too high, but to secure the desired illumination, it is recommended that two magnetite lamps be hung on each post. Otherwise this plan is the same as the first.

The third plan is a substitute for the other two, and is recommended only in case the possible objections to the erection of the isles of safety in the roadway cannot be overcome.

# Illuminating the Country Home

By A. Cressy Morrison.

The question of the source of illumination for the country home is usually limited by the location, so that neither electricity nor city gas can be given consideration. The usual method of illumination is, of course, kerosene. Candles still survive for minor uses, but the serious installation of a lighting system involves several interesting questions.

It is necessary above all things that the illuminant selected shall be safe. It must also be economical, healthful and reasonable in cost of installation. The illuminant selected should also be adequate in candle power, convenient and the quality of the light should be agreeable to the eye, cleanly and instantly available.

Acetylene seems to answer these requirements in every respect. The safety of the modern acetylene system of illumination has been demonstrated by the adoption of new rules and regulations by the National Board of Fire Underwriters, which permit the inside installation of acetylene generators. The new rules were based upon the investigation of the Board of Engineers of the National Board of Fire Underwriters, who reported to the Executive Committee that acetylene, as installed under the rules and regulations of the National Board, was safer than the illuminants which it replaced.

Acetylene has advantages of safety which are not considered from an insurance standpoint. City gas practice is used in piping, and the heat generated by the small acetylene flame is but little more than one-tenth the heat generated by ordinary city gas, and in about the same ratio of one-tenth in comparison with kerosene. Kerosene, of course, is a movable unit, as are candles, so that danger to life from the upsetting of movable units is in the case of acetylene eliminated.

Acetylene has no poisonous quality whatever, and there is absolutely no danger from asphyxiation, no case of this kind having occurred throughout the world. The quantity of acetylene escaping into a room through a ½-ft. burner is so small that danger from explosion from this cause is eliminated, and the perfection of the acetylene generator as now constructed under the direction of the Board of Engineers of the National Board of Fire Underwriters, is acknowledged to be such that it is mechanically safe and practically fool proof.

Calcium carbide is not a hazard, whereas liquid hydrocarbons are a source of constant danger. Hence the question of safety is well settled by the expression of the most authoritative body that could be called upon to consider the subject.

The very small flame of acetylene and its extremely high candle power in proportion to the consumption of oxygen makes acetylene the most healthful of illuminants, with the possible exception of electricity. In this respect there is no comparison with kerosene, gasoline, candles or city gas, as acetylene is far and away the most hygienic.

A ½-ft. burner of acetylene gives approximately 25 candle power of illumination. Acetylene has all the conveniences of city gas, and methods of ignition which are adapted to city gas can be applied with equal facility to acetylene.

The question of the cost of illumination is settled by the fact that it compares favorably with city gas burned in an open flame burner at $1 per 1000 cubic feet. The basis of this estimated cost is plain. One hundred pounds of calcium carbide costs $3.75. Allowing 25 cents for freight, this leaves calcium carbide 4 cents per pound. While calcium carbide will yield 5 cu. ft. of gas per pound under laboratory conditions, the Government guarantee is that it shall yield at least 4½ cu. ft. in a generator. Estimating that only 4 cu. ft. are yielded, the cost per 1000 cu. ft. would be $10.00. Professor Pond, in his recent work on acetylene, credits it with 12½ times the illuminating power of city gas. It is, therefore, seen that there is a wide margin allowed, both in yield of carbide and in the yield of illumination, when the claim is made that it equals city gas at $1 a 1000.

It compares favorably, candle power for candle power and cost for cost, with kerosene, as acetylene in a clean burner is always burned under the best conditions, whereas kerosene is seldom burned in a perfectly trimmed lamp. Therefore, acetylene is economical for the country home.

Questions arise as to the use of acetylene for cooking. When compared with city gas in the city, burned in an ideal gas stove, it costs considerably more, but in the country home the convenience of acetylene for use in the gas stove, especially in summer, and the fact that all the arguments in favor of the city gas stove, as regards waste of coal, cost of kindling, which make the city stoves of such marvelous advantage economically, apply, so that the use of acetylene for cooking as an adjunct to the main system and as an adjunct to the country home is unequaled.

The cost of the installation of acetylene here becomes of a great deal of interest. Taking an average country home of from seven to ten rooms, furnished with carefully designed and well polished gas fixtures, the cost of installing acetylene would be about as follows: A 25-light generator, and by this is meant a generator capable of producing, with one charge, sufficient acetylene to burn 25 lights, giving approximately 25 candle power for ten consecutive hours, would cost $120.00. The burners would cost $5.00; the fixtures, including glass ware, $35.00; the piping, $30.00; freight, drayage and incidentals, $10.00. A generator of double capacity—that is, a 50-light generator, has many distinct advantages, in that it will generate sufficient acetylene so that the question of recharging will occur at double the intervals, and, further than that, should it ever occur that all the lights were lit at once, there would be no danger of the supply of acetylene being exhausted. Such a generator would cost $50.00 more—that is, $170.00—making the toal cost of an acetylene plant of the highest quality for a country home $250.00.

The figures given above are based on the assumption that very artistic fixtures and good glass ware will be adapted for the better rooms, and that simple but artistic fixtures and first-class glass ware shall be used throughout the rest of the house. The piping is ordinary city gas piping.

The installation of the piping and fixtures can be accomplished by an ordinary, careful workman, and can be done in from three to five days and in such a manner that the piping is not visible, nor will the introduction of an acetylene system inconvenience the family.

The acetylene generator is shipped completely set up and has no intricate parts to be adjusted. It can be placed in the basement or in a separate building if so desired. Generators are usually accompanied by complete instructions, which are so simple that they can be followed by any ordinary workman without difficulty.

It has been found in actual experience that a house which is equipped with 25 burners will not burn on an average more than two burners at a time, and according to the season will use these burners for only a few hours each day. A 25-light machine has therefore practically 250-light hours, and should last without recharging for ten days or two weeks, and often longer.

A larger capacity machine, such as is described as a 50-light machine, would probably need recharging, under ordinary conditions, about once a month.

The recharging is accomplished by very simple means, and the residue from the generator is merely slacked lime. This has been found useful for all the ordinary purposes for which lime is used, including that of fertilization, and in this direction has proved very valuable for the garden.

It is, therefore, possible by the use of acetylene to have a complete individual lighting plant always ready for instant use. In the country all the conveniences of city gas, with many advantages over city gas, can be had by the country dweller to-day in acetylene illumination, the nearest approximation to sunlight yet devised in artificial illumination, with a distinct advantage as regards safety, at a moderate cost and to his infinite satisfaction.

Some 150,000 installations in country homes throughout the United States are a demonstration of the appreciation with which these facts have been received, and it is notable that wherever acetylene has been introduced into a community, the neighbors and residents who can afford a private installation have hastened to secure the advantages which each initial unit so clearly demonstrates.

# Some Examples of Faulty Store Illumination

The most expensive goods are not always the best. Every one has had experimental proof of this fact to a greater or less extent, and the truth of the statement applies to lighting installations as well as to merchandise—a fact which can be easily proven by even a casual inspection of a majority of the new stores in the business section of Fifth avenue, New York, from Madison square to Forty-second street. This is the exclusive society shopping district of the metropolis—the section where even the name of the firm or proprietor in the daintiest of gold letters is considered a vulgarity, and where the eyes of the *hoi polloi* are rigorously excluded at night by drawing down the shutters. These things will go in a metropolis, where millionaires are as plentiful as huckleberries (when stocks are up), but let no misguided merchant in a smaller town be deceived into emulating this example.

FIG. 1.

The most fashionable dry good store—not a "department store," mind you—of the city is located at the corner of Fifth avenue and Thirty-fourth street. It occupies an enormous new building extending over nearly the whole block, and is of recent construction. Both the exterior and interior architecture is severely plain and, so far as it can be classified, is an adaptation of the classic Greek. The interior finish is entirely in white plaster. There is a large central court above the first floor extending to the roof. The illumination is by inclosed arc lamps suspended by chains and fitted with specially designed bronze casings and frosted alabaster globes. The design is shown in Fig. 1. These lamps are hung about 12 ft. from the floor and about the same distance apart, on the first floor. Brackets having three cornucopia-shaped arms holding incandescent lamps in an upright positon are placed around the court at the different floors. The difference in color between the arcs and incandescents is, of course, very apparent, the latter looking yellow and sickly. The decorative treatment of the arc lamp is successful to a high degree, but the general effect of the installation is far from pleasing. The lamps are decidedly the most conspicuous feature of the room. It is impossible for the eye to get away from them. They strike it at every turn and distract and hold its attention. There is ample intensity of illumination on the counters and the goods—rather an excess, if anything—but the glare of the unavoidable arc is a serious detraction. The large number of lamps and the long chain suspension produce an effect of a fixture show room rather than an illuminating installation. It was a decided mistake to hang the lamps so low. The white finish of the ceiling, columns and walls would have insured good illumination had the lamps been placed as near as possible to the ceiling. The same criticisms in a general way apply to the other floors.

Directly across the avenue from this establishment is a new building, on the ground floor of which there is a confection-

ery store, which caters to the pampered tastes of New York's blue bloods. The furnishings have been put in with a view of meeting the ideals of this class of trade. The illumination is by chandeliers and sunbursts on the ceiling. The former are examples which, in a way, equal the notorious Pennsylvania Capitol fixtures in the excess of metal used. They support imitation candles having round frosted lamps in place of the candle flame, and are finished in dull gilt. The first impression of the fixture is that the foundryman must have tipped over his crucible when he did the pouring and put in all the metal he had. Why this tonnage should be suspended from the ceiling and decorated with these white firecrackers, is not readily apparent to the ordinary observer. The sun-burst on the ceiling is satisfactory, for the very reason that chandeliers of such exaggerated proportions are unattractive—because of their simplicity and effectiveness—and they are the saving of this installation.

A couple of blocks up on the avenue on the same side is another magnificent building occupied by a well-known firm of silversmiths. The ceiling, which is very high, is broken up into shallow vaulted panels, in each of which there is a fixture supporting a horizontal ring of bare incandescent lamps. While the fixtures are individually acceptable, or would be if they were provided with frosted lamps, the illumination provided is decidedly gloomy. The wall showcases along the inner side of the room have a system of "deck lighting"—that is, lamps placed above an opalescent glass top. The same fault is manifest here as in the general illumination—insufficient brilliancy. It is fortunate in this case that the reputation of the company is such that it, apparently, does not need to utilize an attractive illumination as a means of augmenting trade. It seems a pity, however, that a room otherwise so elegant and magnificent should be so deficient in this important respect.

Still further up on the opposite side is the best known jewelry store on this continent. The ceiling of the first floor is magnificently paneled in old silver. The general illumination is by chandeliers, consisting essentially of a long stem supporting a plaque on the circumference, of which round frosted lamps are studded. The design and workmanship are both exceptionally pleasing; nevertheless, on a dark day when artificial lighting must be depended upon there is a distinct feeling of gloom on entering the store. Perhaps this subdued light is intentional. It may be intended to go along with the antiquated practice of pulling down the shutters at nightfall, and it may perhaps please the particular trade to which they cater; but it is not a safe example for the progressive merchant in a great majority of instances to follow.

Light in itself is hospitable and inviting, and just as there are cases on record of stores which continue to do business without advertising, so there may be those that can carry on a satisfactory trade without this most essential feature of the modern, progressive, and up-to-date merchandise establishment. It is worth remarking, however, that within a half dozen blocks, and in two buildings among the finest in the city and housing the most exclusive mercantile establishments, the one should have such an excessive illumination as to be positively uncomfortable, while the other should have comparative gloom. There is a strong suspicion that "somebody blundered" in both cases, and that neither a forest of arc lamps nor an insufficiency of incandescents is a desirable condition in any store, exclusive or inclusive in its tendencies.


# Tungsten Lamps in a Hat Store Window

By Norman Macbeth.

The value of the tungsten lamp with its high flux density in securing a higher standard of illumination and permitting the installation of the quantity necessary to properly and to a much higher degree illuminate show windows in the comparatively small space usually available, is very clearly shown in the recently completed installation for George W. Allen, Chestnut street, Philadelphia. This firm is undoubtedly Philadelphia's most exclusive hatter and furrier, and as advertisers, appreciate the value of their windows.

The installation of the two windows had to be made on different days, as they would only permit the removal of goods for a couple of hours. The photograph, Fig. 1, shows one window completed, and the other just as same as has been used under the regular conditions of illumination. All the lamps were in use, as may be noted on reference to the top of the curtain in the left hand section. This photograph gives a very good idea of the comparative illumination of each window. Both windows being on one plate, print and half-tone removes any doubt regarding the fairness of the comparison. Fig. 2 is a view of the


THIS SIDE SHOWS WINDOW ILLUMINATED WITH OLD INSTALLATION. FIG. 1. THIS SIDE SHOWS WINDOW WITH TUNGSTEN LAMP INSTALLATION.


FIG. 2.—EFFECT OF PROPERLY DIRECTED LIGHT IN SHOW WINDOW.

tungsten equipped window at closer range and from a point admitting of a better view of the contents. This is not by any means a "shadowless" window, as especial consideration was given to the direction and quantity of light to secure properly defined shadows, which are soft and natural, this condition being especially desirable when showing goods of this character.

The upper portion of these windows was entirely enclosed in glass, without any woodwork, excepting a narrow sash. This sash on the front and side was only of sufficient width to attach a two-wire molding, to which was previouly connected at 9-in. centers a back plate, angle nipple, socket and metal half shade, the latter being the common kind with a white reflecting surface. Each of these 17 fixtures contained a 16 candle-power carbon filament lamp.

It is evident on reference to the left section of Fig. 3 that the electrical contractor had installed all the lamps that could be put in the space available, without commiting that crime in window illumination of putting them in the back and vertically in the corners of the window. However, owing to the depth of these windows (10 ft. 6 in.), and the pitch of the ceiling, from 11 ft. in the front to 6 ft. 8 in. in the rear, practically all the side lighting was within the line of vision of observers.

In the new installation this condition was corrected by using units on the doorway side for about 18 in. only, from the front, the detail of the arrangement of the unit (Fig. 4) is shown in Fig. 5 and in the right hand side of Fig. 3. Seven metal shades of the 15 degrees setting and four similar shades of the 30 degrees setting were used

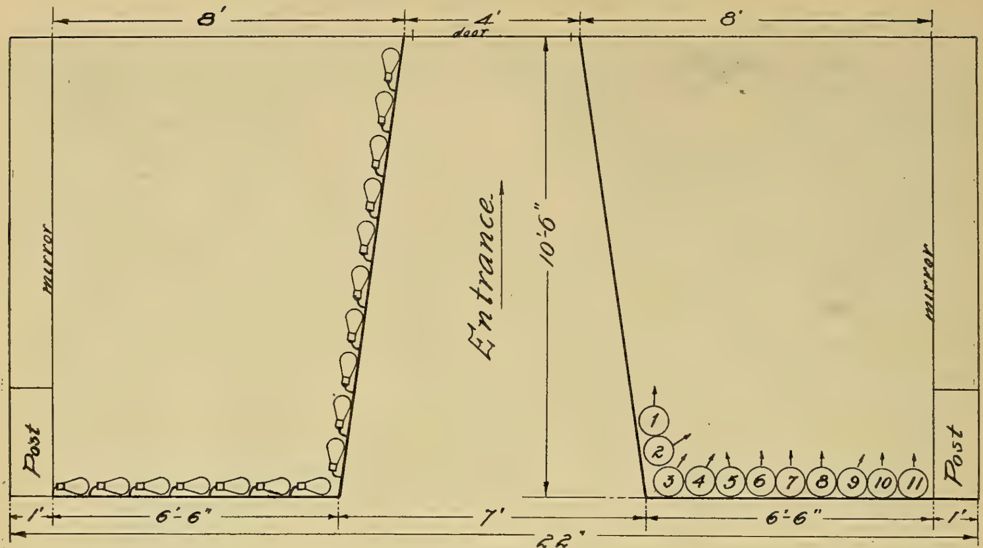



FIG. 3.

in each window, these being attached to a fixture made of ⅞ in. diameter, 17-gauge tube, constructed as a unit to facilitate proper installation in the hour's time allowed. Tungsten lamps, bowl frosted and of the 100 watt and 60 watt size, respectively, were used, the angle shades giving the maximum flux in the proper direction while permitting the lamps to be in a vertical position.

The line of "equal flux density" shown in Fig. 5 is the calculated result to meet the requirement of even distribution from unit quantity in the front of window to three-quarters that quantity in the rear, or equal illumination on the floor at the front and the top of the goods at the rear.

The illumination result extremely satisfactory to this firm was secured with an increase in wattage of approximately 16

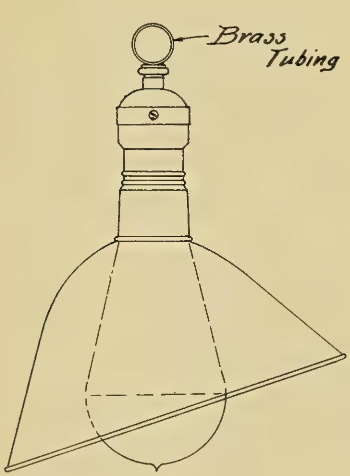



FIG. 4.

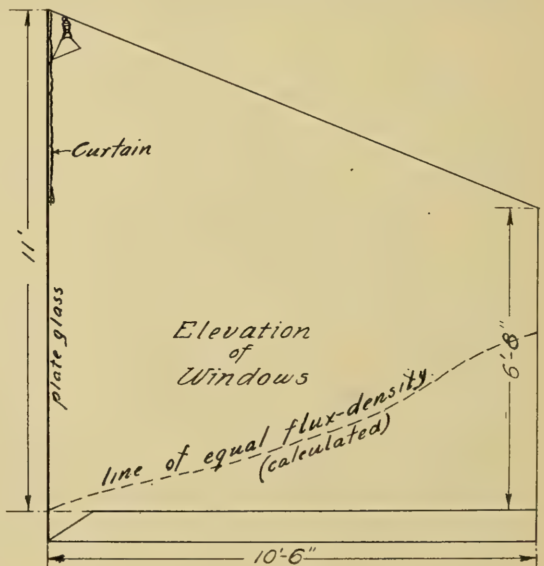



FIG. 5.

per cent. over that used by the carbon filament lamps, an increase in electricity costs of a little over 1 cent per hour per window, about $26 per year total for both windows, assuming 1000 hours' use.

In windows where the display value is considered so high that they would only permit the removal of goods for the short time required to make these changes, the increased and more satisfactory illumination, from comparative darkness to brilliancy, is undoubtedly worth at least 100 times this increased cost, and warrants the policy of using the advantage of the increased efficiency of tungsten lamps in illumination rather than reductions in maintenance costs.

*Summary of Installation.*

| | |
|---|---|
| Width of front | 20 ft. 0 in. |
| Width of window in front | 6 ft. 6 in. |
| Width of window in rear | 8 ft. 0 in. |
| Depth of windows | 10 ft. 6 in. |
| Height at front | 11 ft. 0 in. |
| Height at rear | 6 ft. 8 in. |
| Area of floor, approximate sq. ft | 76 |
| Total area of floor, sq. ft | 152 |
| Total number of 16 c. p. lamps used | 34 |
| Total wattage of 16 c. p. lamps | 1,700 |
| Number of outlets installed | 22 |
| Number of 100 watt tungsten lamps | 16 |
| Number of 60 watt tungsten lamps | 6 |
| Total wattage tungsten | 1,960 |
| Watts per square foot carbon | 11.2 |
| Watts per square foot tungsten | 12.9 |

# Light in the Great Lone Land

By Felix J. Koch.

It is interesting to note the headway which artificial lighting has made in what, but a few years since, was considered "the great lone land of Canada." At Winnipeg the great gas tanks near the railway surprise one. At Humboldt, out in Saskatchewan, the stores use acetylene for illumination, and the effect is good. Beyond here, however, the long twilights save many a light bill. Coming into Saskatoon, in the nights of late summer, the electric lights beam out a welcome along the square. In the stores, however, despite the arc lamps on the thoroughfare, oil lamps are sold in legion. The hotel of course has electricity, and there are incandescent bulbs in many show windows. On the back streets smaller yellow lights twinkle. There is a goodly stock of chandeliers offered in one of the stores.

Up at North Battleford, Chinese lanterns are interspersed with British flags, by way of decoration.

Vermillion has many dark streets, and old-time lanterns still stand at the corners. The fine hall here, however, is lit by acetylene.

As one gets farther on toward the Arctic, the increased duration of daylight impresses the traveler. Even the editorial sanctum here is still lit by oil limps, however. Artificial light here is needed at certain seasons only from eleven at night until half past one in the morning. Not even the prisons of the Royal Northwest Mounted Police, at Fort Saskatchewan and elsewhere, are lit electrically.

Up at Edmonton, most northerly city in America of its size, two huge black lampposts stand out before the Imperial Bank of Canada. The city here owns the electric lights.

At Calgary there is an oil well, and gas is comparatively cheap.

None of these illuminants, however, seem to take so well with the traveler as the aurora.

At Laggan they tell still of how the light of a sudden oncoming locomotive scared a horse, causing a wagon to plunge over the cliffs; for horses here are unused to sudden lights in the darkness. In fact, out here the illuminating engineer would be "a stranger in a strange land."

## Fixtures and Accessories

# Portable Gas and Electric Lamps as Lighting Units

No matter what kind, or how many new and improved lighting units may be developed, and no matter to what extent " fixtures " may be used, the individual portable lamp is sure to retain its place in popularity. This is sufficiently proven by the fact that the candle is still largely used, and even where the newer illuminants are available, its use is apparently on the increase. A time may possibly come in the evolution of the human race when we will take our food in tablets, our stimulants in capsules, and our emotions from perforated rolls of paper; but until that time comes the individual light source, especially if it be a flame, will have a distinct and inimitable value by reason of certain æsthetic instincts that are as deeply rooted as our taste for food. There is a personality, an actual sense of companionship about a lamp that you can take up in your hand and carry where you will, and always have by your side, that is entirely lacking in the mechanical and impersonal " chandelier."

Besides its inherent æsthetic value, the portable lamp is both effective as a lighting unit for many purposes, and a fit object for the almost limitless application of art. For the purposes of reading and writing there is no illumination equal to that provided by a lamp suitably equipped and properly located with reference to the book or table. The room may or may not have other sources of illumination; that will depend somewhat upon its general use and other conditions. If the room is small and a translucent shade is used, no other light source will be necessary. Beyond question the best illumination in its effect upon the eyes is that which gives a sufficient brilliancy upon the particular objects seen, and just enough illumination on other objects to prevent completely black shadows.

It is not uncommon at the present time to find kerosene lamps used for these purposes where gas and electricity are at hand. The reason assigned is always that the oil lamp is " easier on the eyes." This reason, however, is only partially true. The rays of light from either an electric or gas lamp are in themselves no more trying to the eyes than the rays from a kerosene lamp; the trouble arises from the manner in which they are used. It is not uncommon to find them so placed that they shine directly into the eyes, in which case their far greater brilliancy does the mischief. In other cases their greater volume of light produces a glare upon the surface of the paper, and instead of reducing the intensity by using a light of lower candle power, they are discarded in favor of the oil lamp—which is only another method of reducing the illumination.

A very much larger use can be made of portables to good advantage, both in domestic and certain classes of commercial lighting. Where electricity is available abundant baseboard outlets should be provided in all of the principal rooms of a house, so that portable electric lamps can be used at any time and place. In not a few cases portables can take the place of fixtures with advantage to both the artistic and practical sides of the illumination. Libraries and dining rooms are particularly susceptible to this method of lighting. It is beginning to be realized that the more or less unwieldy " dome " of metal and leaded glass which has so largely superseded the conventional chandelier for dining room and library lighting, may readily become an unsightly obstruction, making it impossible to obtain a clear perspective of the room in any direction. A table lamp, with additional lamps on mantle, sideboard and per-


FIG. I.—SOME LATE DESIGNS OF AMERICAN PORTABLE LAMPS.

haps other suitable supports, offers a satisfactory way out of the difficulty.

There is no more artistic or effective manner of lighting the home library than by a suitable table lamp for reading, with portables on the book cases.

In bedrooms the use of side brackets and chandeliers can never entirely take the place of at least one portable lamp. It is generally conceded as a woman's privilege to change her mind as often as she likes, without rhyme or reason; it is equally her habit to change about the furniture in a room without premeditation or warning; and the particular spot on the wall where a bracket has been located by the most far-seeing illuminating engineer may be precisely the spot where the chiffonier must be placed, or the mirror hung. In such contingencies the portable lamp comes gallantly to the rescue.

In commercial lighting the portable lamp finds its greatest use in stores, and it is rather curious that its advantages have been so little recognized. As a method of lighting counter show cases the portable lamp has no equal. It is true that in mere point of luminous intensity concealed lamps within the case may surpass it, but they do not give the artistic appearance to the store that is produced by the portable; furthermore, there is something inviting and confidential in being able to hold an object under the light of a lamp and examine it, as we would do in our own home.

The artistic limitations of portables are less closely drawn than with fixtures. They are always used at close range, and therefore may properly be treated with the most exquisite details of workmanship. Being manifestly parts of the furnishing, their artistic motive is not confined to the architectural or structural features of the building, or even the decorative scheme, but may follow the æsthetic fancy of the owner. The standard of the portable offers a variety of materials for the expression of art and handicraft, including metals of all descriptions, porcelain, glass, wood and enamel. The shade likewise is susceptible of a great variety of effects, which, by reason of its translucency, are impossible with any opaque object; and unlike the "fixture," the portable loses none of its beauty, but shows to its best advantage when lighted.

A number of new and artistic designs in portables are shown in the accompanying cuts, all of which may be used with either gas or electricity. It will be observed that the largest number of these are of the Art Nouveau School. These have been selected for the reason that the older and more conventional designs are already sufficiently familiar to our readers. The use of the Greek column, variously modified and not infrequently distorted, as the basis of the design has been followed by American manufacturers ever since portables have been used. The Greek column is admittedly an exquisite conception as an architectural structure, but to dwarf it to the size of a hand lamp, and to reduce its function from supporting a temple roof to upholding a gas burner and shade, is a debasement of its original noble purpose. The statuette as a support has also been much overworked. Cupid is all right in his place, but he was never intended to perpetually carry a lamp on top of his head.

Referring to the different examples individually shown in Fig. 1, Nos. 1 to 3 are good examples of a motif often used in Art Nouveau—namely, the gracefully curved stems and broad leaves of aquæous plants.

No. 4 is a motif that would harmonize well with the popular arts and crafts furniture.

Nos. 5 and 6 have the graceful outlines of art vases, together with an Art Nouveau decoration on the surface. The shade of No. 5 is particularly striking, using jewels in its effect.

No. 7 is a more delicate expression of the arts and crafts motif.

No. 8 shows the same motif still more refined.

No. 9 is a modern adaptation of classical motifs.

No. 10 is an example of wrought iron work, which is always acceptable in rooms having a large amount of cabinet finish.

No. 11 is a graceful piece of the Dutch Colonial type.

Nos. 12, 13 and 14 are candle-stick effects; the two latter taking their treatment from designs of the Georgian period.

No. 15 is a distinctly Art Nouveau design shown equipped with an inverted gas lamp.

Nos. 16 and 17 show an exceedingly

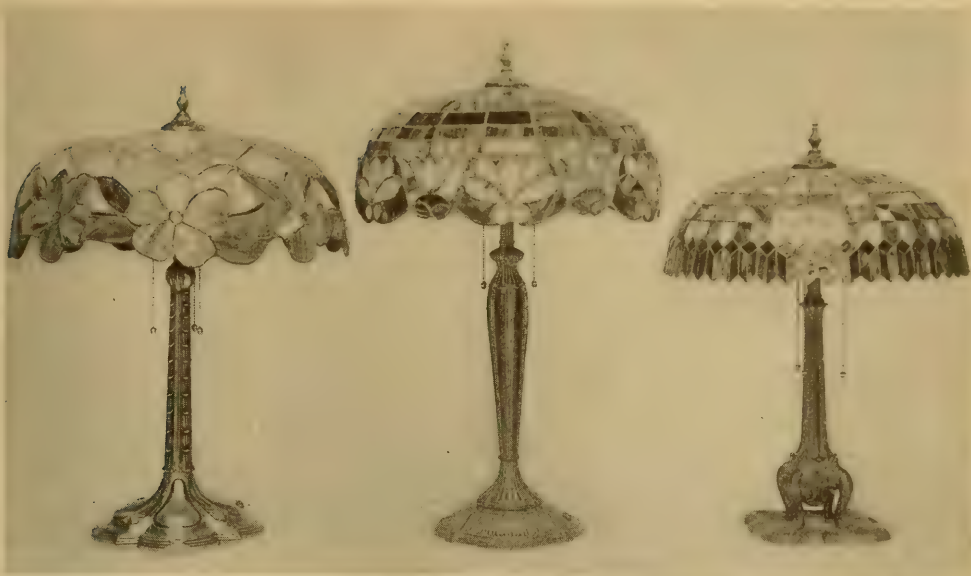


FIG. 2.—A COMBINATION OF ART AND UTILITY.

clever device, by which a table lamp may be used as a bracket. The shell shade is happily used in this case, being serviceable, as well as exquisitely beautiful.

Nos. 18, 19 and 20 show other designs of this same device.

No. 21 is a graceful specimen of subdued Art Nouveau.

The three lamps shown in Fig. 2 are particularly graceful designs, and the shades fine types of leaded glass construction.

All of these examples are of moderate price, so moderate, in fact, that there is really little excuse for the use of many of the atrocities that have been offered in the name of art.

# Illuminating Engineering and the Fixture Trade

We commented in our last issue on the fact that the development of illuminating engineering, and especially the recent improvements in both electric and gas lamps, were making decided changes in the methods and ideas of fixture construction which have maintained ever since gas has been a commercial illuminant. The older manufacturers well remember the time when the designing department was a mere incident; the real business of manufacturing was carried on in the foundry. Tons of gas fixtures were produced in at least one of the State penitentiaries. Even the largest manufacturer would scarcely turn out a half-dozen new designs in a year. Partly owing to the introduction of the electric light, and partly to the general progress in the appreciation of the artistic, fixture manufacture has emerged from this primitive condition, and become more and more a matter of art metal and glass work.

The manufacturer who has been running on successful lines for a number of years invariably looks upon all inventions and events which tend to produce changes in either the construction or commercial aspects of his business with suspicion and misgivings. New designs, whether purely mechanical or in decorative features, mean outlay on what is apparently a dead asset. The inventory of the pattern room and the modeling department is always a painful duty. It therefore requires no small degree of confidence in one's foresight and courage in his convictions to discard the old designs or patterns and reach out after the new: it is, in a way, discounting the future. The one consolation and inspiration to those who follow this method is the un-

doubted fact, proven by innumerable examples, that the really great successes in business have been achieved by just such foresight which has furnished a sound basis for discounting the future. The first skimming gathers the cream; those who come after must be satisfied with skimmed milk.

There has been a surprising lack of appreciation of the manifest trend of affairs in the fixture trade. There are fixture manufacturers to-day who are hugging the delusion that the tungsten lamp is only a passing fancy. Meanwhile its use continues to grow as rapidly as facilities can be expanded for producing it; and in mere self-defense the lamp makers have had to encourage the establishment of new manufactories to turn out fixtures adapted to the new conditions. For the advent of the "scientific fixture" and its amazingly successful career, the old-line manufacturers have only themselves to blame. While they have been pooh-poohing illuminating engineering and the new light-sources, the more progressive element have foreseen the inevitable changes that these new conditions must bring about, and have been quick to seize upon them and turn them to commercial account.

The so-called "scientific fixture" contains little that may properly be called science, but a very considerable that is good common sense. Briefly described, the scientific fixture is simply a lighting apparatus stripped of practically all superfluous metal, particularly such as would interfere with the illuminating results, arranged to support the new high-efficiency electric lamps or inverted gas burners in the proper position, and equipped with glassware designed to give the most advantageous distribution and diffusion of the light. The result is a fixture of simple design and construction and therefore at least inoffensive from the artistic standpoint, which is more than can be said of a good many of the old-line fixtures.

Perhaps the most noteworthy innovation is the importance which the glassware has assumed in connection with fixtures. For a hundred years past it has been customary to consider a "globe" or "shade" as an individual piece of glass, to be selected regardless of its relation to anything else, and for which a lighting fixture furnished a place of support; what effect it might have upon the resulting illumination, or to what extent it harmonized with the decorative treatment of the surroundings, were matters of which both manufacturer and user knew little and cared less. The consideration of a globe as an optical instrument and the development of prismatic glass designed on a basis of geometrical optics, has completely changed conditions in this respect. The commercial introduction of prismatic glass has been a purely heroic struggle, but being based upon science and therefore strictly in line with the progress of the times, its ultimate triumph was inevitable. As in all other cases of improvements, the originators have only been a small part of those who reap the benefits. Every manufacturer of lighting glassware to-day is in a stronger and higher position by reason of the influence of the prismatic globe. A shade or globe to-day is not simply a piece of blown or pressed glass, whose value is determined by its weight, or the ignorance of the buyer; it is an essential part of a lighting unit, and its value is determined by the merit which it possesses in securing either utilitarian or artistic effects, or both.

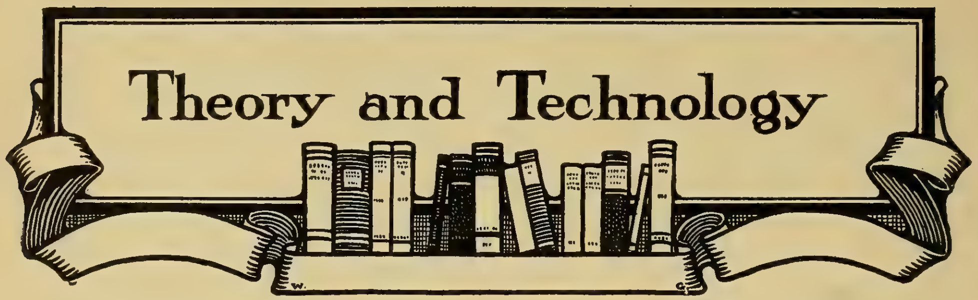
As the design and construction of lighting fixtures is being revolutionized by the new conditions, so the methods of selling must also undergo a similar change. When fixtures were turned out in the foundries like plow-points, they could be sold in much the same way. When the difference in chandeliers was principally a matter of the number of arms, they could be kept in bins by the dealer like pipe fittings and handed out to the gas fitter or wireman in the same way. Ignorance and indifference on the part of the user, however, are fast disappearing, and with knowledge is sure to come a demand for a voice in the design of the fixture.

Direct appeal to the consumer is the keynote of modern merchandizing. The days when the purchase and sale of goods was a business duel between merchant and customer are happily past. The spirit of investigation which, in the possession of scientists, was responsible for the change from the conditions of the dark ages to those of modern civilization has spread to the public at large and affects every action and motive of life. The Missourian has no monopoly of the desire to be shown. The

masses are no longer an ignorant minority, but possessed of a degree of knowledge that not even kings and philosophers could command a few centuries ago; and this knowledge naturally applies itself to all phases of activity. In short, the individual to-day is doing his own thinking instead of taking his opinions ready-made from the traditional and musty sources of the past.

The user of light (and who does not use light?) who wishes to make a selection of lighting fixtures must journey to the nearest show room of the manufacturer or dealer. There he is ushered into a room which is a veritable jungle of gnarled and twisted metal, the branches interspersed with vari-colored flowers and fruit of glass, with roots on the ceiling. If he can succeed in forming a mental picture of any single fixture as it would look if placed in the particular location for which he desires it, he is possessed of an extraordinarily vivid imagination. If he despairs of making a selection from this bewilderment of metal, or if he happens to be in a small town where only a few "samples" are carried, he may be offered the privilege of inspecting the "catalogue"—a huge folio which strongly suggests the old time photograph album that was invariably handed out to the guest in the farm house parlor. Here are pictures of the fixture family and its ancestors unto the third and fourth generations, each dressed in the prevailing fashion of its time. To make confusion worse confused, the "shade" manufacturer's album is of similar proportions and character. It would be an interesting mathematical problem to figure out the number of combinations that could be made by combining the two. The mathematician might also determine by the laws of his science the probability of a single customer being satisfied with any or all of these combinations. But there is where mathematics would fall down and the idiosyncrasies of human nature prevail; the actual probability is at least two to one that the customer, while making a selection for the reason that he has got to have a fixture of some sort, will go away dissatisfied, and with a vague feeling that it was not *just* what he wanted, but "will do."

The whole system in vogue at the present time for the merchandising of lighting fixtures is going to undergo a radical change in the next ten years. Stock designs are going to have less and less importance, and originality and artistic merit a far greater value. The consumer is going to be the arbiter in the case, aided by his architect and decorator. Fixtures will be more distinctively separated into classes, such as domestic, semi-commercial, commercial and purely utilitarian. Both semi-commercial and commercial fixtures will be constructed on somewhat different lines, but in all classes, except the strictly utilitarian, better art will prevail, and the value of the fixture will be determined, not by the amount of metal which it contains or the persuasiveness of the salesman, but by its fixtures, artistic and practical, to fulfil the conditions under which it is to be used. Time-worn designs will be relegated to the scrap heap, and instead of the customer being bewildered with an historical exhibition, he will be assisted by a few suggestive designs, which will fill much the same purpose as the artist's preliminary studies. The business which not long ago was considered a fit occupation for convicts will become a recognized branch of applied science and art.




# Plain Talks on Illuminating Engineering

By E. L. Elliott.

## No. 18.—Some Further Considerations of the Flux of Light Method

We will begin by reviewing the example given in the last issue, and in which there were a number of numerical errors. In the example taken it was assumed that the number of effective lumens, determined by measuring the intensity of the light upon the assumed surface, was 1000, and that in producing this illumination 20 incandescent lamps of 13 m.s.c.p. (the ordinary output of the 16 candle-power lamp) had been used. The total number of spherical candles is then 20 x 13, or 260; and since there are 12½ lumens to each spherical candle, the total number of lumens is 12.5 x 260, or 3250 lumens. Dividing the effective lumens, 1000, by the lumens generated, 3250, we get slightly over 30 per cent. efficiency. If we wish to be more exact we should use 12.57 for the number of lumens per mean spherical candle; 12½, however, is a much easier figure to remember, and is sufficiently accurate for all ordinary purposes.

To obtain the number of lumens given out by the lighting unit within certain angles we mentioned the method of Cravath & Lansingh, which consists in drawing a number of radial lines—for convenience in calculation either five or ten—at angles which can be determined by mathematical calculation. Diagrams so drawn are shown in Fig. 1. These are of sufficient size so that tracings, either on cloth, paper, or, best of all, sheet celluloid, can be made direct from them and kept for this purpose. They include the three angles which are most commonly required in the calculations necessary to lay out an installation. In order to enable those who wish to make other similar diagrams, a table of angles is given below.

To make a determination from these diagrams, it is necessary to simply place the tracing over the distribution curve, read off the candle-power values at the points where the radial lines cross this curve, add these together, and divide by the number of radial lines on the diagram. This result, however, is the average flux density, or mean zonular candle-power, and must be multiplied by the factor given on the diagram—3.14—to reduce it to lumens.

As suggested before, it will greatly facilitate calculations as to the number of units and the amount of gas or electricity required to prepare tables showing the effective lumens, and the energy required by the various units in most common use. For example, the 60-watt tungsten lamp equipped with a diffusing reflector, giving a distribution such as that shown in Fig. 2, will give the following amounts of light in effective lumens:

| | |
|---|---|
| 30° | 50.52 |
| 45° | 116.44 |
| 60° | 195.68 |

For general illumination the 60 degree angle may be taken. Placing the 60 degree protractor on the polar distribution curve, Fig. 2, and reading intersections of radial lines, we obtain 58, 60.8, 61.5, 64.8, 66.3, 68.6, 65.6, 62.8, 59.8 and 56 candle-power, respectively, a total of 623.2, which divided by the number of readings (10), gives a mean candle-power of 62.32. This multi-

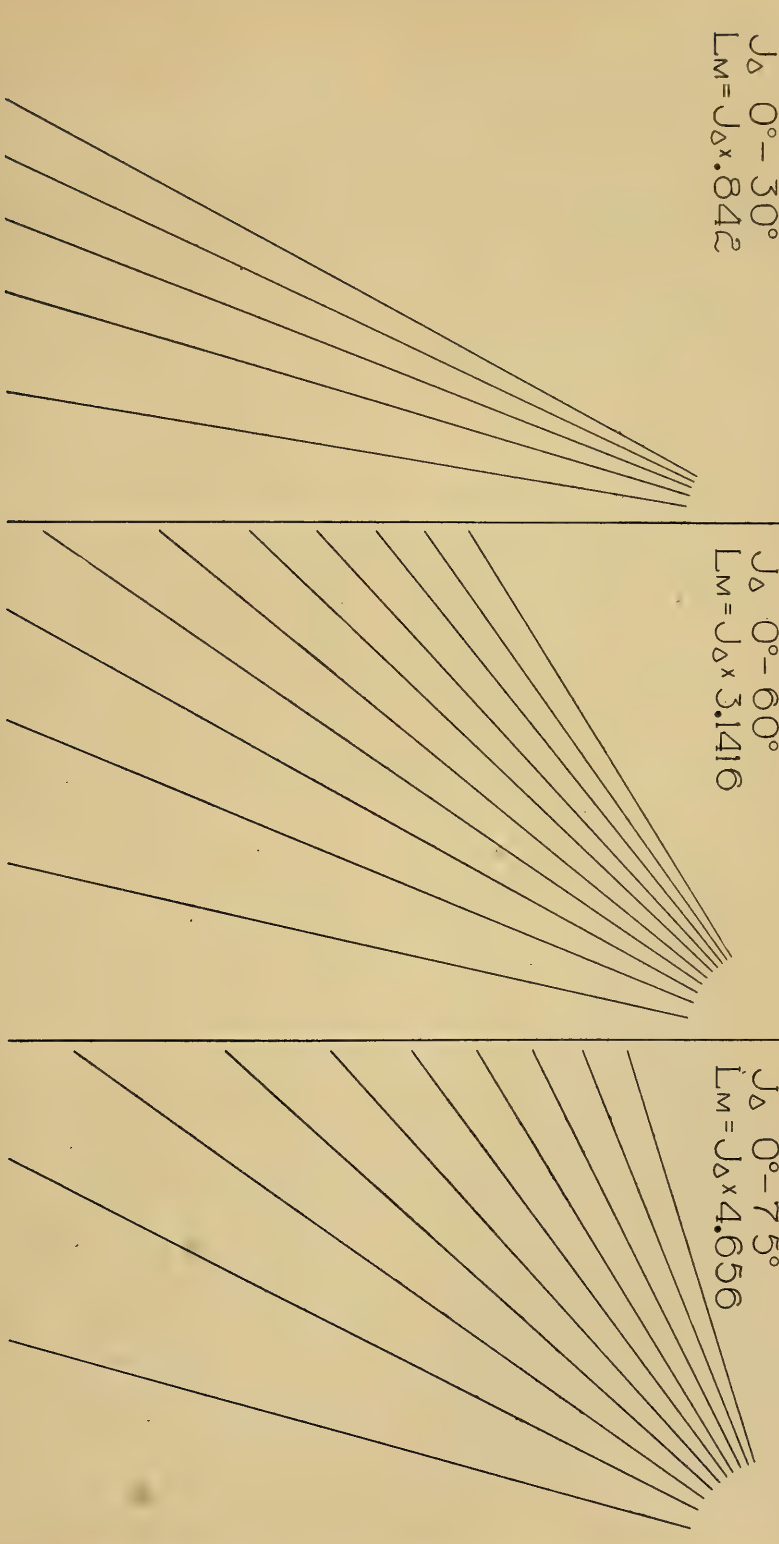



FIG. I.

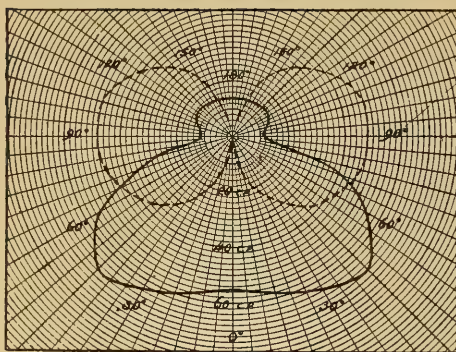


FIG. 2.

plied by 3.14 (the 60 degree lumen factor), gives 195.68 lumens, as shown above. To illuminate our assumed space, having a surface of 500 sq. ft. with an average intensity of two foot-candles, and requiring therefore 1000 lumens, would require 1000 divided by 195.81, or 5 units of the kind mentioned. As each of these requires 60 watts, the total number of watts required will be 300.

Making a similar calculation with gas as the illuminant, we may take the inverted mantel burner, fitted with a prismatic reflector, which gives 475.71 lumens within the angle of 60 degrees, and consumes 3 cu. ft. of gas per hour. Dividing 1000 by 475.71 lumens we obtain 2 as the number of lamps required. Multiplying this number by 3 we get 6 cu. ft. per hour as the total amount of gas which would be consumed.

It will be seen that with the data required in these calculations, tabulated, the calculation of the number of units and the amount of illuminant required can be made offhand with a little arithmetical work. This is not only useful to the illuminating engineer for his own information, but is particularly advantageous when figuring with a client in regard to proposed changes or plans.

We wish to repeat, however, that these calculations have nothing to do with the problem of distributing the illumination. Furthermore, they do not take into consideration the question of reflection from walls and ceilings. This element in the problem is very generally neglected in making calculations. There are several reasons for this course. In the first place, the amount of reflection can never be pre-determined by any theoretical rules, for the reason that there are too many variables in the conditions. Two colors that appear the same to the eye will not give equal amounts of reflection, much less two different colors that appear to be of about the same brightness. Again, the amount of window and door space, as well as the space occupied by furnishings, is an indeterminate quantity, which is never twice the same. Lastly, if sufficient illumination is provided without counting any addition from such reflection, the gain from this source may be considered as a sort of factor of safety. However, there is a very considerable difference in the actual results between rooms having dark walls and particularly those having dark ceilings, from rooms which are finished entirely in white, a condition not infrequent at the present time. The only safe guide, however, is the empirical results obtained from measuring up the illumination from actual installations, and formulating general rules from the collection of such cases. Cravath and Lansingh have published the results of a considerable number of cases, which form a good beginning for this valuable data. The results which they obtained are as follows:

INCANDESCENT LAMPS.

Tungsten lamps rated at 1.25 watts per horizontal candle-power; clear prismatic reflectors, either bowl or concentrating; large room; light ceiling; dark walls; lamps pendant; height from 8 to 15 ft. . 0.25

Same, with very light walls . . . . . . . . . . . . . . 0.20

Tungsten lamps rated at 1.25 watts per horizontal candle-power; prismatic bowl reflectors enameled; large room; light ceiling; dark walls; lamp pendant; height from 8 to 15 ft. . . . . . . . . . . . . . . . . 0.29

Same, with very light walls . . . . . . . . . . . . . . 0.23

Gem lamps rated at 2.5 watts per horizontal candle-power; clear prismatic reflectors either concentrating or bowl; large room; light ceiling; dark walls; lamps pendant; height from 8 to 15 ft. . . . . . . . 0.55

Same, with very light walls . . . . . . . . . . . . . . 0.45

Carbon filament lamps rated 3.1 watts per horizontal candle-power; clear prismatic reflectors either bowl or concentrating; light ceiling; dark walls; large room; lamps pendant; height from 8 to 15 ft. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 0.65

Same, with very light walls . . . . . . . . . . . . . . 0.55

Bare carbon filament lamps rated at 3.1

watts per horizontal candle-power; no reflectors; large room; very light ceiling and walls; height from 10 to 14 ft., 0.75 to 1.50

Same; small room; medium walls...1.25 to 2.00

Carbon filament lamps rated 3.1 watts per horizontal candle-power; opal dome or opal cone reflectors; light ceiling; dark walls; large room; lamps pendant; height from 8 to 15 ft.................. 0.70

Same, with light walls.................... 0.60

### Nernst Lamps.

Nernst lamp, 110-watt single glower; opaline ball globe; no reflector; large room; light ceiling; medium walls............ 0.50

Westinghouse-Nernst lamp; 88 to 264 watts; opaline ball globe; no reflectors; large room; light ceiling; dark walls.... 0.39

Same, with light walls.................... 0.31

### Arc Lamps.

5-ampere, enclosed, direct-current arc on 110-volt circuit; clear inner opal outer globe; no reflector; large room; light ceiling; medium walls; height from 9 to 14 ft................................ 0.50

### Gas Lamps.

Cu.-ft.-per-hr. Constant.

Inverted mantle burner, clear cylinder, clear prismatic reflector; large room; light ceilings; dark walls................ 0.01

### To Apply Rules.

To apply the above rules, for electrical units: watts per square foot equals foot-candle intensity multiplied by constant from table.

For gas units, cubic feet per square foot equals foot-candle intensity multiplied by constant from table.

The calculations involving the flux of light principle are not so difficult as they might at first appear, and by the use of the rules and formulæ which have been given they are easily within the reach of any one having no knowledge of mathematics higher than arithmetic. On account of the quickness with which calculations can be made and the general information which is afforded by the results, it is well worth while for all those having to deal even casually with questions of lighting to familiarize themselves with this method.

### Angles for Flux-Polar Diagrams.

| 20° | 30° | 45° |
|---|---|---|
| 6° 18′ | 9° 23′ | 13° 54′ |
| 10° 55′ | 16° 18′ | 24° 12′ |
| 14° 6′ | 20° 5′ | 31° 24′ |
| 16° 42′ | 25° 1′ | 37° 20′ |
| 18° 58′ | 28° 26′ | 42° 35′ |

| 60° | 75° | 90° |
|---|---|---|
| 12° 50′ | 15° 39′ | 18° 12′ |
| 22° 20′ | 27° 17′ | 31° 47′ |
| 28° 57′ | 35° 27′ | 41° 25′ |
| 34° 25′ | 42° 13′ | 49° 28′ |
| 39° 11′ | 48° 12′ | 56° 38′ |
| 43° 32′ | 53° 41′ | 63° 15′ |
| 47° 33′ | 58° 47′ | 69° 31′ |
| 51° 19′ | 63° 38′ | 75° 31′ |
| 54° 54′ | 68° 17′ | 81° 22′ |
| 58° 20′ | 72° 47′ | 87° 8′ |

After following carefully different methods of calculating illumination, and taking into consideration the ever-present exceptions to rules and indeterminate quantities, the query is likely to arise: If there are so many discrepancies and variations which cannot be accurately predetermined, what is the use of all this close figuring? Would you not be about as close to give a random guess? The argument sounds plausible, but is fallacious. Guessing is *never* as good as calculation. There is no case in the entire range of applied science in which actual conditions fulfill all the requirements of theory. Judgment, the value of which depends to a large degree upon experience, can never be dispensed with in any engineering problem. There are always indeterminate variables and unknown quantities. The "factor of safety," which appears in all cases of mathematics applied to engineering, is a recognition of the fallibility of pure theory. The measurements and calculations of illumination which it is possible to make with the best data that we now have at hand enable results to be obtained which are comparable with those used in other branches of engineering, and are far more reliable in the long run than the most accurate guessing of even an experienced Yankee. The logical way is, therefore, not to discard mathematical work, but by the constant accumulation of data, obtained from actual results, to afford means of producing more and more close approximations to the theoretical requirements.


## Physiological Effects of Light

The fact has been frequently dwelt upon that illuminating engineering has to deal with the physiological effect of light, as well as with its physical properties; but only the effects which have to do with the sensation of vision have been discussed. Light is one of the very many forms of radiant energy. The startling discoveries of Professor Roentgen, to which he gave the name "X-rays," in modest recognition of their unknown properties, were the starting point for a line of investigations of the nature of ether waves, which in its importance and far-reaching results may be likened to the incomparable pioneer work of Pasteur in the domain of micro-organisms. While much has been learned, comparatively speaking, of the physiological effects of ether vibrations, we are undoubtedly as yet but on the threshold of this vast and important branch of natural science.

Whenever we produce artificial light, we generate not only the particular waves which produce the visual sensation, but a greater or less variety of accompanying waves which do not thus effect the organs of vision. As the search for higher luminous efficiency continues, and new methods of producing light waves are discovered, the question of the action of the invisible radiations becomes of increasing importance. The precise effect of ultra-violet rays is just now receiving much attention from oculists and other scientific investigators, and there is by no means unanimity of opinion as to their effects. As in all other cases the progress of scientific knowledge, definite and safe conclusions can be drawn only from the accumulation of a large number of individual facts, and this requires both time and scientific knowledge.

Eye strain is undoubtedly responsible for many ills that are either ascribed to other causes or left as unsolved enigmas. Many a case of chronic headache, originally charged to indigestion, has been cured by the proper use of glasses.

The effect of colored light upon both vegetable and animal tissue is very marked, and in itself offers an extensive and important field for investigation. That different colors produce different psychological effects is also a recognized fact, and in at least one institution has been turned to account in the treatment of the insane.

These facts and instances will indicate the complexity and extent of the physiological problems connected with ether vibrations, all of which, to a greater or less extent, are connected with the general problem of illumination. He who dismisses the subject of lighting with the remark that "there is nothing in it" declares his own ignorance of the very fundamentals of the subject.

The importance of light in its relation to health is brought forcibly to public attention by the International Tuberculosis Exhibition, which is now being held in this city. The desirability of having an abundance of light and air in dwellings, and all other places where human beings must spend any portion of their time, has long been recognized; but the positive value of these agencies in checking disease, and particularly in the treatment of the justly so-called "white plague," has only recently begun to be appreciated to the full. That rooms from which the sunlight was perpetually shut out acquire a certain musty smell, and are usually damp and unfit for

human habitation is no new discovery. The exact relation between the cause and effect, however, is one of the great scientific discoveries of the present age—namely, that light-rays and other similar forms of radiant energy have a destructive action upon many of the dangerous forms of micro-organisms. When the only sources of light were the flames of lamps and candles this effect was wanting in artificial light. Our latest modern light-sources, on the other hand, are fair equivalents for direct sunlight in their chemical and physiological effects.

Aside from the moral effect of natural light, there is no reason why an artificially lighted room should not be quite as healthful as one lighted by the sun's rays. We do not wish to minimize the value of the psychological or moral effect of sunlight; no artificial light can take the place of the natural product, any more than paintings can take the place of natural scenery; but from the strictly physiological point of view artificial light may compete with natural light in every respect. The dark and unwholesome basement, or underground room, need no longer exist. As the commercial buildings of the large cities tower farther and farther upward, there is also a tendency for them to go deeper and deeper into the ground. The result is that there are an increasing number of rooms which can never receive daylight illumination; but with our modern means of heating and ventilating, and by the use of modern light-sources, such rooms, for all purposes for which they will be used, can be made quite as healthful as if they were lighted by the sun's rays.

One of the most inexplicable follies of humanity has been a tendency to shut out sunlight where there was every opportunity for receiving it in full measure. Windows are put in houses, and then blinded and curtained in every conceivable manner, until the interior is lighted at best only with the obscurity of twilight. If there is any blessing in this world which is not only free, but actually insists upon being accepted, it is sunlight; and except in the hottest of summer days, and then during the cooler portion of the day, it should be allowed to flood every possible part of the house, office or factory. Not to make use of this free agency of health and cheer is a piece of stupidity too crass to be tolerated in this age of enlightenment.

## Indirect Lighting

The most obvious fact that confronts the amateur illuminating engineer is, that a bright light source in the field of vision is tiresome to the eyes. The first item in his hand-book is therefore likely to be: "Keep all light sources hidden or keep down their brilliancy by diffusing shades." Against the wisdom of this prescription little or no argument can be adduced; the difficulty arises when attempts are made to carry the rule into practice.

A method which has attracted a great deal of attention and discussion, both in this country and in Europe, is the system of so-called indirect lighting, which consists in projecting the direct light against a white or light tinted ceiling, and utilizing the diffused reflection for general illumination. On superficial consideration this method would seem to fulfill every theoretical requirement. The light sources can be readily hidden by opaque reflectors, or in concealed spaces, and the diffusion of light from the large surface is practically perfect. The only serious objection that has been raised is the comparatively low efficiency due to absorption by the reflecting surface.

While theory is not to be neglected in illuminating engineering any more than in any other branch of applied science, there is a far greater need of judging results by their actual effects. Illuminating engineering has this very vital distinction from other branches of engineering; it deals ultimately with physiological effects, while all the others deal with mere physical, chemical, or material results. The final test of any system of illumination is its effect upon the eyes of those who are subjected to it. Put to this test, indirect lighting falls far short of the high theoretical perfection which is claimed for it.

The peculiarly trying and wearisome effect upon the eyes of sunlight diffused through a light fog is a well recognized fact among those accustomed to being on or near the water. As a further illustration, consider the case of trying to read or perform close eye work under the open sky, without the protecting shade of a hat brim; and, lastly, of working in a room having a

large extent of skylight. The difficulties encountered in all of these cases are proof positive that any method of illumination which approximates these conditions will be trying and injurious to the eyes.

The objects that we naturally see are rarely at an elevation. By far the larger majority of objects to which the eye gives close attention, *i. e.,* focuses sharply, are below the line of vision. The eye naturally looks down at things. All extraneous light, *i. e.,* light not coming from the objects looked at, makes vision more difficult. To assist the eye in this respect it is protected by the upper eyelid with its lashes, and the projection of the forehead; and civilized man early learned to increase this protection by artificial means. Close vision is practically never attempted under natural light without some artificial means of cutting off the overhead light. If we are to have light from the ceiling, therefore, we should be allowed to wear hats or eyeshades.

Again, in nature we normally see things by directed light, *i. e.,* light coming from one direction, that of the sun. When this condition is overthrown, as in the case mentioned of the diffusion of light through a thin fog, eye strain at once results. Directed light is essential to perspective, which is one of the essential elements of vision. A room lighted on all sides by windows is exceedingly trying to the eyes, as any one knows who has experienced it.

As a method of producing general illumination for actual working purposes, therefore, the indirect method is open to most serious criticism. The one class of cases in which it might be valuable is that where a comparatively low general intensity is required, as, for example, in offices or shops where special illumination is provided for each person.

Aside from its optical defects, indirect lighting gives an unnatural appearance to a room. Under ordinary daylight conditions the ceiling of a room is its darkest part, and while it is true that too much shadow on the ceiling gives an appearance of gloom, it is equally true that a ceiling lighter than the floor gives an uncanny and unnatural effect.

Indirect lighting is, therefore, both from the physiological and æsthetic viewpoints, very far from being the *summum bonum* of illumination that it is so often claimed to be. In fact, there is no other system of lighting which needs to be adopted with greater caution, nor handled with more careful consideration.

## Danger in Electric Signs

The Herald Square Theatre in New York was recently set on fire and partially burned as the result of a faulty installation of a large electric sign. The burning of a theatre is always a spectacular, and frequently a tragic event. It is not strange, therefore, that this particular fire should have furnished a text for more or less eloquent discourses on the dangers of all electric signs. It is to be hoped, however, that too great haste will not be shown in jumping at the conclusion that all electric signs are menaces to public safety. The facts in this particular case are, that the electric installation was carelessly made in the beginning; was not kept in proper repair, and the circuit breaker operating the changes in the sign had been enormously overloaded. The actual cause of the fire, it appears, was a bare wire which had gotten loose and made a short circuit by being blown against a contact. The means of preventing such contingencies are easy enough to provide; periodic inspection by the proper authorities, either at regular intervals or whenever changes are made in the sign, would practically eliminate accidents of this kind.

That there is some risk attached to the large electric signs which are now such a feature in this and all other prosperous cities cannot be denied. There is some danger wherever an electric wire is run, and the only way to entirely eliminate the danger is to dispense entirely with electricity. An electric street car is a decided source of danger as compared with the old horse car, but we do not think of dispensing with its services on this account; the problem is to reduce the danger to the minimum, and this rule should hold with regard to the electric sign. Electric signs are a distinct attraction to any city, and should be encouraged in every legitimate way. It is the business of city governments as well as fire insurance companies to see that electrical installations of all kinds are put in with a due regard to such rules of safety as have been found feasible and necessary. If this is applied to signs as to other installations,

there is no reason why they should not be effective in checking carelessness, unintentional or otherwise. If we were to dispense with every element of danger in modern life we would find ourselves back in the condition of the cave-dweller.

## "Honor to Whom Honor Is Due"

The lack of agreement among the different nations upon a standard of light, and even upon the relation which the several standards bear to one another, has long been a serious handicap to the progress of photometry. Recognizing this fact, the Illuminating Engineering Society more than a year ago started a movement looking toward an agreement upon an international standard. To this end a Committee on Nomenclature and Standards was appointed. This committee took the matter up with the two other scientific societies which are directly interested in photometry, namely, the American Institute of Electrical Engineers, and the American Gas Institute. The three societies then proceeded to take the matter up with the National Bureau of Standards, Washington.

The result of the movement thus far is to arrive at an agreement among the three American societies and the Bureau of Standards upon a value for the candle-power standard. The matter is now being negotiated with the German, French, and English authorities. The Société Technique, and the Syndicat Professional de l'Industrie du Gaz, of France, have officially resolved to support the American proposition, and to communicate their acceptance to the French Minister of Commerce and the Gas Associations of other countries.

There seems, therefore, every prospect that an international standard will be agreed upon as soon as the necessarily slow movement of the large bodies concerned can be consummated. When this has been accomplished, let the honor be bestowed where it is due—upon the American Illuminating Engineering Society.

## Eighty Cent Gas in New York City

The United States Supreme Court has unanimously decided that illuminating gas can be made and sold at a profit in New York City at the rate of 80 cents per 1000 cu. ft. Incidentally, the Court also decided that a corporation having a monopoly of a public utility has no good-will of commercial value. It is difficult to see how the decision could have been otherwise, both as to the point decided and the unanimity of opinion. Whether the amount of present profit is a fair and reasonable one the Court did not attempt to decide, but put it squarely up to the company to go ahead and honestly see how much it can make.

The case has been an exceedingly important one from many viewpoints, and the conclusions reached will be of far-reaching influence. Among these the following are of general application:

First.—A public utilities corporation, especially if it have a monopoly, will be allowed to make a fair rate of profit, but no excessive dividends will be permitted. Just what a fair rate of profit is will depend somewhat upon local conditions. Throughout the East it seems to be pretty well agreed that 6 per cent. is about the limit on an honest capitalization.

Second.—A monopoly of a public utility may be so regulated by government control as to protect both the public and those operating the monopolistic corporation; therefore, a monopoly is not necessarily in itself an evil.

The public in general is probably not aware of the fact that, in common with all other classes of manufacture, the cost of the materials used in producing illuminating gas has been constantly increasing within the past 10 years. Furthermore, that the cost in the particular case decided was increased at the same time that the lower price was enacted, by raising the candle-power standard. Insisting on a high candle-power standard for illuminating gas is a serious mistake on the part of legislators. The largest use of gas at the present time is for heating, and, as is generally known, the most economical results as to light are obtained by the use of the mantle burner, and this quite regardless of the illuminating power of the gas used.

What the people want is the cheapest gas obtainable having a satisfactory heating value; instead of putting obstacles in the way of the manufacture of such gas every effort should be made to facilitate it, and the greatest single assistance that could be given would be the abolishment of the candle-power standard and the substitution of a calorific standard.

# Correspondence

## From Our London Correspondent

It will be remembered that in an early number of The Illuminating Engineer we contributed an article upon high pressure gas, and gave an account of the work done by Mr. Scott-Snell. Since that time much progress has been made. These compressors are made in varying sizes passing 80 cubic feet per hour, or 3000 candlepower capacity and upwards. So perfect is the working of the compressor that the motion is continuous, the pressure remaining constant whatever the number of lights connected up. The inventor tells us that the cost in gas for the three different systems for 1500 hours, with gas at 60 cents per 1000 cubic feet, works out for 60 candlepower in each case as follows: For "flat flame," $18; incandescent low pressure, $2.70; "Scott-Snell" high pressure, $1.35. The method has been adapted to street lighting, and is both economical and efficient: when once the compressor is started the working is entirely automatic.

Much interest is taken and many advances have been made in the use of compressed gas for the lighting of railway carriages. The manufacture of Pintsch gas has been very much improved, and quite recently a new gas has been prospected under the name of "Blaugas"; this gas has been successfully liquefied under 100 atmospheres pressure, so that the same bulk of gas which was transported in cylinders of considerable size on ten or fifteen ton trucks can, in the liquid form, be sent out in small cylinders only a few feet long and of small diameter, very like those used for oxygen and hydrogen gas. This new illuminating gas is as clear as water and is produced by the distillation of mineral oils in iron retorts: Chemically it consists of the same elements as coal gas, but in considerable different percentages. We have before us a table of comparison between the lighting and heating power of "Blaugas" and the other gases, which we reproduce:

| Gas. | Heating value units per cubic metres. | Light value in Hefner candles. Incandescent burner. |
|---|---|---|
| Air gas passed over benzol, or light hydrocarbons | 2,800 | 500 |
| Coal gas | 5,000 | 700 |
| Oil gas and compressed | 10,000 | 12,000 |
| Oil gas compressed | 8,500 | 950 |
| Blaugas | 13,833 | 2,700 |
| | | Flat flame burner. |
| Acetylene | 1,300 | 1,666 |

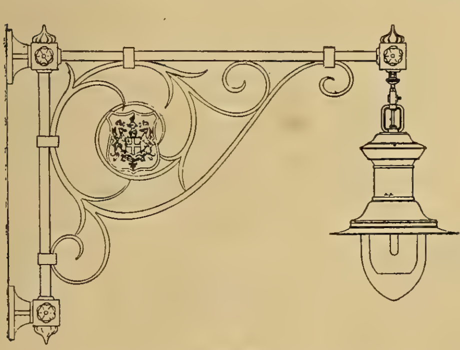
The gas may be filled into light steel cylinders of various sizes in a liquid condition, and can be transported any distance. The smallest cylinders contain 0.25 kilo., or 0.49 litre, of liquefied gas, and the largest cylinder at present adapted for separate transportation contains 25 kilos., or 49 litres, of liquid under a pressure of 100 atmospheres. This quantity would be suffi-

NEW STREET LAMPS FOR INVERTED GAS BURNERS.

cient, states Mr. F. D. Marshall, to feed one flame of 50 candle-power in an incandescent burner for 1238 hours, or for 310 days at four hours per day. This is a wonderful advance upon any other method of compressed gas supply. It is stated that one kilo of "Blaugas" will give 3000 candles at a cost of 3 cents per 3000 candle hours.

We give two illustrations of new street lamps fitted with inverted incandescent burners. These burners are being very generally adopted for street lighting; the consumption of gas is very small and the illuminating duty per foot of gas very high. The special feature of the lamps illustrated is that in all cases angle burners are used, which enable the primary air supply to be absolutely uncontaminated, as it never comes into contact with the products of combustion. The two-light lamp has, of course, two mantles; the nozzles are of standard size to take ordinary mantles, but the gas supply to the burners can be regulated for mantles of different sizes. With mantles of 30 mm. in depth the consumption would be 2.75 cubic feet, and with mantles 54 mm. in depth, 3.25 cubic feet per hour, so that the illuminating power obtained is about 30 candles per cubic foot. The fact that the top, or roof, of the lamps are hinged is a distinct advantage, being of great service in keeping the glass clean. One advantage of the inverted burner over the upright, especially for street lighting, is the low cost of maintenance. The small projecting cylinders are not nearly as expensive as chimneys nor are they so subject to breakage.

The lighting authorities of the city of London are again busy, in association with



NEW TYPE BRACKET FOR INVERTED GAS LAMPS, FLEET STREET, LONDON.

the Gas Light and Coke Company, arranging to light Fleet street with bracket lamps and inverted incandescent burners supplied with high pressure gas. We give an illustration of one of the latest designs. In this busy street the roadway is narrow and the traffic "prodigious," so that it is hoped that the adopting of bracket lamps and the consequent removal of lamp columns will give a little more room to the foot passengers.

Although so many improvements have been made during the last two years in the use of coal gas as an illuminant, the makers of apparatus for the manufacture of acetylene gas are by no means idle. A plant has been put down at an important station on one of our southern railways—Brockenhurst—and gas is supplied to platforms, refreshment rooms and all signal lamps, some 200 burners being lighted. The total candle-power supplied is stated to be 9000 or thereabouts, but the plant is capable of supplying 20-candle gas to 660 burners for a period of six hours. We are told that the present price is equivalent to coal gas at 60 cents per 1000 cubic feet, or the electric light at 6 cents per unit.

C. W. Hastings.

London, January, 1909.

## From Our Baltimore Correspondent

Lighting Superintendent Robt. J. McCuen has sent his report for the year 1908 to the Mayor for his consideration. This report, which is exceedingly practical and to the point, shows that 337 arc lamps, 25 gas lamps and 181 naphtha lamps were installed during the year on various streets throughout the city. At the present time there is in service on the streets of Baltimore 7199 incandescent gas lamps, 989 incandescent naphtha, or vapor lamps, and 2091 electric arc lamps, making a grand total of 10,279 street lamps of all kinds.

The cost to the city for the various lamps is as follows: Electric arc, $67.49 each lamp per year; mantle gas lamps, $19.45 a year, including gas; mantle naphtha, $25.00 a year; and for the supply of gas, 72½ cents 1000 cu. ft.

As required by law the usual photometric tests have been made for the purpose of determining the candle power and the quality of illuminating gas furnished the public by the gas company. This law requires that

the gas for all purposes shall not be less than 20 candle power and free from all impurities; the result of these tests show that the average candle power has been 21.48 and the pressure 2.15. The Lighting Department inspected and tested 24,977 gas meters for the gas company and 70 for customers who made complaint to the city; of this last mentioned 61 were found to be registering correctly and 9 incorrectly, and only 19 were found defective out of the large number tested for the gas company.

A special illumination of Druid Hill avenue, one of the important thoroughfares of Baltimore, was directed by ordinance of the City Council in honor of the National Negro Business Men's Convention. It consisted of loops of incandescant lamps suspended across the street from house to house, and in the center a miniature court of honor was erected, surmounted by a crown of lights.

The Gas & Electric Company and the American Lighting Company have actively co-operated with the Lighting Department in every requirement, with the result that the street lighting service has been maintained at a very high standard of efficiency; and after all disbursements have been made the department still has a balance of $3166.81 to its credit.

It is the intention of the Superintendent of Lighting to insert an advertisement in several prominent journals of the country asking information relative to the most modern street lamp fixture, with a view of either purchasing such fixtures, if it is possible to do so, or if the same cannot be purchased outright, then to include these fixtures in the specifications for the new contract and require each bidder to submit figures upon such fixtures. Considerable work has been planned for the year 1909, and approximately 300 additional arc lamps are to be installed and a large number of gas and naphtha lamps.

The Lighting Department does not entirely rely upon the statement of the gas company as to the consumption of gas by the city, but the district superintendents each month read the gas meters, making their report to the office, which reports are compared with the bills rendered by the gas company. Mr. McCuen has again renewed his recommendation for municipal supervision over corporations in the lighting business; a plan of this character would be a protection both to the public and the lighting company, for it would to a large extent shield the lighting companies from unwarranted attacks by irresponsible patrons, and would be the means of suggesting remedies to right well-founded complaints by the public. Of course, it would require additional inspectors to carry on this work properly, these men to be stationed at the plants of the lighting companies and keep the city posted on matters pertaining to the service.

The city of Baltimore has been offered a proposition from the Gas & Electric Company to supply the city with current and power for municipal buildings at the flat rate of 6 cents per kilowatt hour. The contract proposed would embrace the current supplied to all school houses, fire engine houses, police stations, parks and squares and City Hall Annex; at present the current is supplied on different contracts made by the various departments, the average price paid has been 7.16 cents per kilowatt hour. The new rate, however, will enable the city to save about $4000.00 a year, which sum can be appropriated toward the installation of additional lights this year. The new proposition came as a pleasant surprise to the Mayor and Superintendent McCuen, and it is believed to have been the result of the agitation for a municipal lighting plant by Mr. McCuen.

The city of Cambridge, Md., agreeable with the terms of the contract between the municipality and the lighting company, the electric lights were placed in service for the first time December 10, the streets were beautifully illuminated and the public seemed delighted with the new lighting system. Only the main streets have been lighted at this time, but as the Commission sees fit additional lights will be installed from time to time, and within a short while the entire town will be illuminated. At present the town is lighted with 11 arcs and 22 incandescent lamps.

SYDNEY C. BLUMENTHAL.

BALTIMORE, January, 1909.


# Mrs. Tungsten's Suggestion

By Guido D. Janes.

" Guess I won't make an assignment to-day," remarked Charles Tungsten the other A. M., as he said good morning to his wife.

" Why ? "

" Because my sales increased fifty per cent. after dark last night. Most unusual phenomenon in clothing store history. I was afraid to tell you at first, for fear you would think I was kidding you. If the said phenomenon gets busy again you may yet be able to face the cruel world with a bank account."

" Oh ! thank you for pausing in the assignment proceedings," cried Mrs. Tungsten, beside herself with happiness. " You know Margerie is to make her debut next fall, and should your vocation become under the weather the preferred creditors would snub us at the debut. I hate to come before the public at fifty cents on the dollar."

" I will do my best to restore comfort and ease to your mind, dearest." After saying which he strolled away to carry on his business.

" But I can't see why all of a sudden he should make a success in his calling. Ever since the gas works burned, and he had to depend upon kerosene to light up his store, his sales have fallen off awfully. Two years ago we associated with cashiers, directors and bond holders ; now we entertain credit men and bill collectors. It makes me cry every time I think of it." Whereupon the good lady filled her room with sobs and kept the place well stocked with same until dinner. Then she stopped. " But I mean to investigate the affair," she said aloud to herself. " After the meal I will journey down to the store and figure out where the phenomenon came from."

Accordingly at half after five, when she had dressed for the afternoon, she boarded a street car on the new Troop Street line and made a bee line for her destination.

" What lovely headlights your car has," said Mrs. Tungsten to the conductor who had come around for his nickel. " They make things along the route look prominent and important."

" Yes'm. New electric ones the company put on. You sees there is a three-minute schedule along here, and we gots to have illumination enough to prevent colisions."

" You go right by the Tungsten Clothing Company, don't you ? "

" Yes'm, but we didn't until yesterday.

" YES'M."

Just opened up the new branch line there."

"O, I see now—why—why my—"

"What?"

"I was just talking to myself. I have a habit of doing so."

"Oh." And the conductor, having secured his money, withdrew, leaving the one to whom he had been talking, peering out of the forward window in a most absorbed manner.

"I know why my dearie has suddenly hit it rich," she added, "see if I am not right. When the car swings into Troop Street I shall know."

"Troop Street!" cried the conductor.

"Now!" And as the car turned the corner it threw its headlight straight in her husband's show windows. Trousers, shirts, coats, etc., stood out in bold relief against the contiguous blackness. "I knew it! I knew it!" she remarked almost hysterically, "the joke is on hubby. The next corner please, conductor."

When the car stopped she got off, and with a smile on her countenance and a bound in her walk, she entered her husband's place of business. "Mr. Tungsten, I have a joke to tell you," she began.

"I am sorry," remarked he, "for the good news that I told you this A. M. was the joke, if there is any at all."

"How come?"

"Trade has been awful. Not a soul hardly has come in until a few minutes ago, and then only every three minutes. Wait, here comes one now."

"Sure I will wait, after which I will spring the joke on you for yours and mine are different."

"Explain," said Mr. Tungsten twenty seconds or so later, after ringing the cash register.

"Well, to make a short story long, an Italian fruit dealer makes a success by associating his wares with plenty of illumination. Without light there would be no business life. People or customers are the moths, merchants the candles, illumination the flame; do you get next to the analogy?"

"No."

"Dunce, of course you do. Now, the new electric line that runs by here has elec-


"AND THEN ONLY EVERY THREE MINUTES."

tric headlights on the cars. Your store is located on the corner. When they turn into this street from High Avenue some flux strolls into your show windows. Moths come along, and they see your bargains, see that you are doing business, see that you have some life. Cars pass every three minutes. How often did you say you had a customer?"

"Well, I declare. How did you—you happen to figure it out, dear little wifie? You are fit to stand beside Cæsar and give command. You are a Tungsten cluster; you are my success, my queen, my guardian; give me a kiss."

"I will, provided you 'phone to some one this very next minute. No telling how soon the cars will take off those headlights. Besides, you want to have internal illumination as well. What if some customer should come here some dark day and stumble? If injured he would sue you: if not, he would get sore and never patronize you again."

"A kiss and I shall do anything you say." And having secured same, he called up Brown 189 over the old 'phone and said "hello:" some one made the same remark at the other end of the line.

"Is this the Acme Electric Company?

"IS THIS ACME ELECTRIC COMPANY?"

Well, send down some watts, currents, incandescent lights, a flaming arc, a meter and an illuminating engineer to Tungsten's Clothing Store. I want to take my store from under a bushel. I can't depend upon skylights and kerosene lamps any longer."

# Architects and Lights

Miss Loie Fuller created for herself an international and lasting reputation by utilizing the possibilities of colored light in connection with what has been termed the "poetry of motion," otherwise the dance. While most of the stage dancing is more properly the doggerel or parody of motion than actual poetry, the definition applies with peculiar aptness to the creative and original work of Miss Fuller. She has lately been writing her memoirs for the New York *Herald,* which are both instructive and entertaining. Any one who has sufficient original genius to create a new departure in an old art which will attract the attention of the world is worth listening to. Among her various experiences and opinions, she makes the following very significant comments as to the relation of architecture to illuminating engineering:

"At the time of my arrival in Europe I had never seen a museum. The life I led in America gave me no opportunity to admire art. The first gallery I visited was the British Museum, in London. Then I wandered through the National Gallery. Later I studied the works in the Louvre, and at succeeding times had an opportunity to see most of the galleries in Europe.

"Aside from the masterpieces gathered together in those buildings what struck me most in all the museums I went through was that their architects had paid no attention to light effects. In consequence of that defect every one of them impressed me as an incongruous combination. When my eyes fall on objects and I look at them for a few moments my vision becomes dimmed and I find it impossible to separate one object from another. I have often wondered whether some day this whole question of light will be better understood.

"Illumination, reflections, the rays of the sun falling on objects are such essential problems that I cannot understand why so little importance is given to them. I have nowhere seen a museum where the lighting scheme was per-

fect. The panes through which the light enters and the lamps which illuminate the different halls ought to be hidden or shaded, so that the objects in them may be contemplated without the eyes being molested by the glare.

"It should be the aim of architects to diffuse light. There are a thousand ways of doing this. In order that light should give the best results it ought to be focused directly on the pictures and statues, instead of striking them by chance.

"Color is decomposed light. The rays are broken up by molecular vibrations on touching any object. This decomposition of which a photograph is imprinted on the retina is always the result of various chemical changes in the matter itself and in the rays of light. Each of these effects is designated by the name of color.

"Our knowledge of the production and variation of these effects is exactly in the same stage when music was—when there was no music."

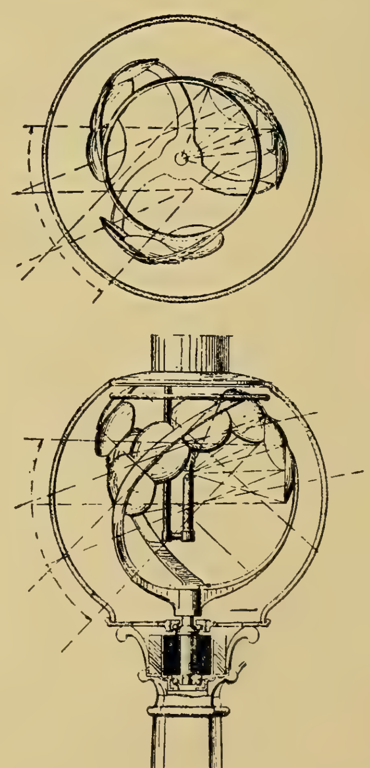
## Is There Anything Wrong with This Scheme?

More than one inventive genius has conceived the idea of getting the full amount of illumination from an incandescent electric lamp by the use of a fraction of the ordinary current, by rapidly switching the light on and off. When such a lamp is turned out it takes a fraction of a second for the carbon to cool below the point of incandescence, and probably a still larger part of a second for the effect upon the retina to disappear. Taking the two together there is an apparent effect of the light continuing after the current has been shut off. Therefore, reasons the inventive genius, if the lamp can be switched off and then turned on again just before its luminous effect has disappeared, the eye will get the same impression as if it were burning all the time.

A Frenchman by the name of J. Lafitte, of Biarritz, has patented a device based upon the same theory, but worked out with far greater ingenuity. The principle which he proposes to use may be described as follows: Suppose that a search-light beam be directed against a distant object: That object will appear brilliantly illuminated. If the beam were then suddenly extinguished, or removed, the impression upon the retina of the eye would continue for about a tenth of a second, *i. e.*, the eye would continue to see the illuminated object for that length of time. If the beam were again directed against the object before this tenth of a second had fully elapsed, the eye would again see the object, and there would thus be the sense of continuous vision.

To utilize this phenomenon, M. Lafitte proposes to place a series of parabolic reflectors, arranged in a peculiar manner, around a focusing arc lamp, and by causing those to revolve rapidly about the arc, to project a beam of light in rapid succession over different points of the space to be illuminated. The proposed construction is shown in the diagram herewith. The reflectors are placed on a helical-shaped frame work, so that the projected light from each reflector can have an unobstructed path through the opposite side of the frame. By causing this form, with its reflectors to rotate rapidly the space covered by the projected light will be alternately illuminated by the beam and left in complete darkness.

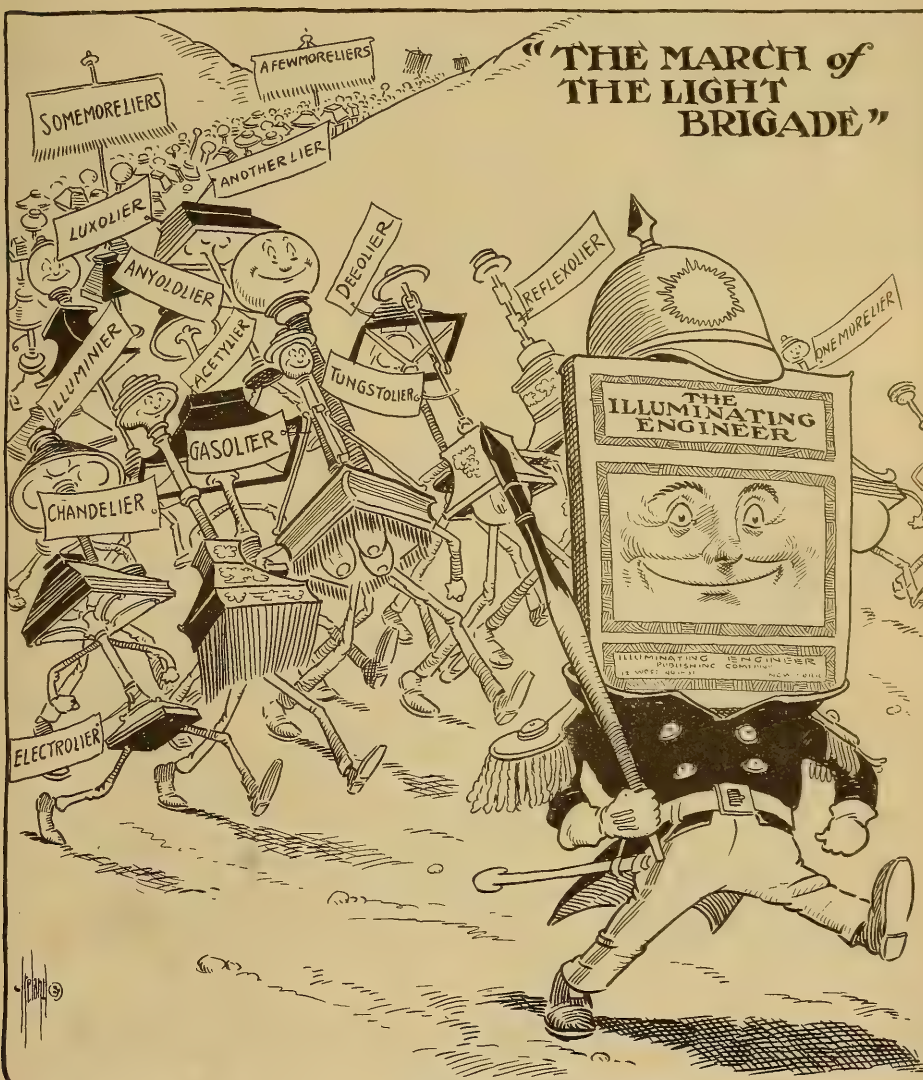
Is there a fallacy in this scheme, and if so, what is it?



REVOLVING REFLECTOR FOR LIGHTING DISTANT SPANS.

CASHIER BOOKKEEPER CONTRACTS ADVERTISING

# Commercial Engineering of Illumination




**GET IN LINE!**

FIG. I.—EXTERIOR ILLUMINATION, GAS APPLIANCE EXPOSITION, CHICAGO.

# The Convention of the National Commercial Gas Association

Since the gas industry has no single national organization which covers the entire field in the comprehensive manner of the National Electric Light Association, comparisons must be made with the conventions of its separate organizations. The recent convention of the National Commercial Gas Association, together with the Gas Appliance Exposition, which was held under the joint auspices of the Commercial Association and the Gas Institute, may properly be compared with the commercial part of the N. E. L. A. Convention and its exhibition of electrical appliances.

Some comments relative to the exposition appeared in our last issue, but these were based purely upon inferences drawn from the list of exhibitors. Interviews with those who were present and further printed reports affords material for further comments. Fortunately, or unfortunately, according to the viewpoint from which they are observed, these comments must largely take the form of criticism. "A prophet is not without honor save in his own country and in his own house," but the critic is usually without honor anywhere save among the enemies or competitors of those criticised. Nevertheless, "an open confession is good for the soul," and the honest critic is one who makes open confessions vicariously, who confesses the sins of others. Honest criticism sincerely offered has never yet been known to injure any one—except the one who made it.

The illustration herewith is from a photograph of the interior of the building in which the exposition was held, and may serve to "point a moral" as well as "adorn a tale." Compare this in your imagination with the interior view of any electrical show or exposition; recall the countless electrical lights arranged in festoons, in outlines, in groups, on chandeliers, and in every conceivable manner, to lend an impressively bewildering sense of gaiety and brilliancy to the scene. Then look at the picture before you and measure in your

# Proceedings of Technical Societies

W. H. GARTLEY, PRESIDENT.

## The Annual Meeting of the Illuminating Engineering Society

The third annual meeting of the Illuminating Engineering Society was held on Friday evening, January 8, in the rooms of the Machinery Club, Hudson Terminal Building, New York. The meeting was preceded by an informal dinner, at which

Prof. Elihu Thompson was the guest of honor. Much to the regret of those present, Professor Thompson was obliged to withdraw immediately after dinner in order to present a paper to the American Institute of Electrical Engineers, and was therefore unable to speak farther than to briefly indorse the work of the society.

The report of the treasurer showed a most satisfactory condition of the Society's finances, there being a net balance in the treasury of something over $2000.

The result of the ballot for officers for the ensuing year, as reported by the Committee of Tellers, showed the unanimous election of the entire ticket put out by the Nominating Committee as follows:

President, W. H. Gartley, Philadelphia.

Vice-Presidents, George C. Keech, Chicago; J. S. Codman, Boston; C. O. Bond, Philadelphia.

Secretary, Preston S. Millar.

Directors, A. S. McAllister, New York; E. N. Wrightington, Boston; George Ross Green, Philadelphia.

Under the head of " new business " the question of devising some method of classifying the members so as to distinguish between those who are primarily interested in illuminating engineering and those who are only interested in some of its collateral branches, or have a general desire to see the cause promoted, was brought before the meeting by a motion that the chair appoint a committee to consider ways and means of accomplishing this purpose and report to the council from time to time. The motion elicited considerable discussion, the general trend of which was to the effect that it is desirable for the Society to offer the widest possible opportunities and inducements for every one to join who is in any way interested in the subject, and that it should, as far as possible, work along educational lines. There seemed to be little difference of opinion as to the desirability of the Society's ultimately making a distinction in its membership, but that any action looking to this end should be taken only after the most mature deliberation. The fact that such an action will require a change in the Constitution, which cannot possibly be effected before the next annual meeting, is in itself a sufficient evidence that no hasty action is contemplated. That the Society has thus recognized its responsibilities to the public and to the other professions by looking forward to distinguishing between those who may properly be called illuminating engineers and those who only have an incidental interest in the subject, or are amateurs or novices seeking knowledge, is of the highest importance, and marks another step in the remarkable progress of this newest of the scientific societies.

The election of Mr. Gartley to the presidency is, without doubt, a source of universal satisfaction to the members. Mr. Gartley is the chief engineer of the United Gas Improvement Company, a corporation which operates a number of large gas companies, and which has long been known as one of the most progressive corporations of its kind in the country. The technical ability connected with this company is strikingly shown by the large number of unusually valuable papers which have been contributed to the several gas associations by members of its engineering staff. Mr. Gartley has personally taken a deep interest in the Illuminating Engineering Society from its beginning, and his own personality is such as to insure a strong, aggressive and enthusiastic administration of the office. In the special field of illuminating engineering Mr. Gartley is an authority upon photometry as applied to gas lighting.

The selection of a president from those identified with the gas industry is a significant fact, and one particularly gratifying to all interested in the full development of the science. There has been some misunderstanding upon the part of the public in regard to the scope of the Society, some assuming that it dealt only with electric illumination. The election of Mr. Gartley, and the greater interest which the gas industry in general will undoubtedly take in its proceedings from now on, should not only serve to dispel this error, but should materially aid in keeping a just balance beween the two principal illuminants now in use. The Society is certainly to be congratulated upon its new official staff.

# Review of the Technical Press

## American Items

Cyclopedia of Applied Electricity; six volumes, 2896 pages, 2000 illustrations; special price, $18.60: American School of Correspondence, Chicago, Ill., 1908.

To review this Cyclopedia is to review the entire subject of electricity. Only the briefest survey, therefore, can be attempted here. As in other cases of Cyclopedic works, the authorship is divided among a number of specialists, who are particularly qualified to treat the different divisions of the subject. In this case particular attention has been given to selecting writers who are not only qualified in point of knowledge, but in the ability to present their specialty in a simple, comprehensive, and attractive manner. The book is not written for the scholar, but for the learner; and from the necessarily superficial examination which we have given it, this vital point in a work of the kind seems to have been accomplished with a rare degree of success. Except such scientific investigations as necessarily demand the use of higher mathematics, there are very few subjects which, in the proper hands, cannot be made comprehensible, and even fascinating, by being treated in a lucid and common-sense manner. This Cyclopedia is apparently the work of teachers, of those who by actual experience know how to look at the subject from the learner's point of view, an absolute necessity to clear writing.

Unquestionably, electricity is the most fertile, extensive, and absorbing field of study, whether one be interested in the subject merely as a branch of general knowledge, in its theoretical development, or in its practical applications, in the whole range of natural science at the present day. The old idea of a liberal education has been entirely revolutionized by the progress of science. There is not a phase or condition of modern life which is not touched in some way by this still mysterious and protean force; and certainly no one can justly claim to possess a "liberal education" who is ignorant of that which bears so intimate a relation to modern civilization. A comprehensive work on electricity is, therefore, as essential to the home library as are the literary cyclopedias.

It is as an educational work, however, that the greatest value of this cyclopedia lies. The possession of this single work is a far greater source of education on this subject than was a school or college a generation ago. It is not possible for every young man to go to college, but it is possible in much more than a figurative sense for the college to go to every young man. Any one having a common school education, who will possess himself of this cyclopedia, and apply himself to a study of any of the divisions of the subject, or the subject as a whole, with persistance and continuity of purpose, and supplement his study with observation and practical work, can give himself a better technical education than many a student obtains from a regular school course.

While the publishers make no claims to philanthropy, their work is distinctly a movement which must have a very considerable influence in raising the standard of knowledge and intelligence among a large field of workers. The books are offered on an installment plan, which puts them within the reach of even the smallest salaried workman.

**List of Works in the New York Library Relating to Illumination**

A pamphlet of 49 pages, reprinted from the Library *Bulletin,* December, 1908.

This is the most complete bibliography on the subject of illumination that has ever been collected, to our knowledge, and as such is of general value to all those interested in the subject, whether or not they have access to the New York Library. It is far more than a mere catalogue of books, as it gives references to articles pertaining to the subject that have appeared in periodical literature. The careful division of the subject into a number of different departments adds materially to its value.

INDIRECT ILLUMINATION, by Augustus D. Curtis; *The Central Station,* January.

Substantially the same article as appeared in the December issue of THE ILLUMINATING ENGINEER.

A SUGGESTION FOR STREET LIGHTING WITH TUNGSTEN LAMPS, by H. H. Geary; *The Central Station,* January.

Deals with the method of using arches over streets for the support of tungsten lamps, and illustrates the installation on Canal street, Grand Rapids, Mich., as an example.

LARGE "WIRE" LAMPS VS. ARCS, by Alton D. Adams; *Municipal Journal and Engineer,* January 6.

The two types of lamps are compared as to cost of current and maintenance, with results decidedly in favor of the metallic filament lamps.

STREET LIGHTING IN SAN FRANCISCO; *Municipal Journal and Engineer,* December 16.

A short article dealing mostly with the statistics of the subject.

STREET ARCHES IN MICHIGAN CITIES; *Electrical World,* December 19.

Illustrates an installation of this kind in Big Rapids, a town not far from Grand Rapids, whose installation has been previously mentioned.

SHOW WINDOW ILLUMINATION BY INVERTED GAS ARC AND PRISMATIC REFLECTORS, by Charles E. Blood; *Light,* December.

Describes a novel show window installation in Portland, Maine.

The panels in the window are of the most expensive quartered oak and the central position of the top was removed, making an orifice large enough to admit a concentrating holophane bowl, No. 1611, Class A, which is held in place by a brass ring and so showing only the glass hemisphere. The new inverted incandescent five-burner arc lamp was hung in this bowl, having the tips of the mantles about 3 in. from the bottom of the bowl proper.

With the inverted incandescent arc light used in this position, on actual test, it was found that the window lighted with electricity had 4 degrees higher temperature than the window lit with gas, and both windows exactly alike. Hygrometric tests showed a condition of atmosphere exactly alike.

The quality of light the electricity showed was a reddish tinge, and the pure white light of the incandescent gas arc and prismatic glass installation showed true daylight value.

In the installation in question, a perfectly uniform lighting effect is produced. The light-source is entirely concealed, and is so placed as to be accessible from the inside of the store without in any way disturbing the window exhibit.

MULTIPLE REFLECTING SHOW WINDOW DEVICES AND GAS ARCS, by "R"; *American Gas Light Journal,* December 28.

Describes a number of means of using mirrors to light up all sides of goods in show windows.

PRACTICAL GAS ILLUMINATION WITH INVERTED BURNERS; *The Architect and Engineer,* December.

Deals principally with the "Reflex" inverted gas lamp.

THE ILLUMINATION DESIGNED FOR A CLOTHING STORE, by J. R. Cravath; *Electrical World,* January 2.

The installation consists of single tungsten units for regular use, with four-light inverted gas chandeliers for emergency service. Plans and illustrations are given, and the installation very fully described.

LAMP-POSTS VS. STREET ARCHES, by Albert Scheible; *Electrical World,* January 2.

A comparison of the two systems, in which the faults of street arches are pointed out, and the conclusion reached that posts furnish the better method.

mind the extent of the lost opportunity for showing the possibilities of gas as a modern illuminant. The space is illuminated with sufficient brilliancy to display the goods, but that is all; there is nothing of the fantastic, nor the spectacular, nor the purely decorative in the installation. It is a practical confession by the gas interests that gas illumination is utilitarian only; that aside from its cheapness and practical serviceability, it is out of the race with its electrical competitor.

It does not require the imagination of a commanding genius to picture what this hall might have looked like had the full possibilities of gas illumination been utilized. As has been pointed out in these pages before, gas light has one distinct advantage over electricity for spectacular purposes in the very nature and appearance of a luminous flame. Any luminous object is attractive, but a flame is positively fascinating because of its life and movement. What never-to-be-forgotten effects could have been obtained by a liberal but artistic use of varied sizes of gas flames! Again, there are the small mantle burners which are as adaptable to outline and decorative lighting as the incandescent electric lamp, and quite as easy to install. Large and small inverted burners are quite competent to compete with the new high-efficiency electric lamps in point of brilliancy and artistic grouping, and yet they are conspicuous chiefly by their absence.

Doubtless the gas interests are not seeking to enter this particular field of illuminating engineering, which the electric interests hold in undisputed sway; but it most certainly would have been an impressive object lesson as to the present possibilities of gas illumination, and the fact that improvement and progress have by no means been wanting with this illuminant.

If the opportunities for an impressive display of gas lighting were lost on the interior, what shall we say of the exterior lighting, as shown by the illustration in Fig. 1? Here we have simply a grim fortress with a row of "gas arcs" suspended over the sidewalk from gas pipes projecting from its frowning walls. What would this building have looked like had it been housing an electrical exposition? Imagine the magnificent archway over the entrance outlined in incandescents; the battlements on the corners projected by lines of glittering light; and the sombre façades transformed into the semblance of a gorgeously illuminated chateau or casino by the clever use of this same means. Are none of these effects possible by the use of gas light? At least the windows could be illuminated.

Among those who visited the convention and exposition was Mr. Charles M. Cohn, secretary of the Consolidated Gas, Electric Light & Power Company of Baltimore. His impressions and opinions are surely worth listening to. In a number of respects he expresses himself as being "keenly disappointed; there were no high-efficiency single mantle lamps to be found on display, and although these units could be used to good advantage to replace the cluster lamps, up to the present time they

FIG. 2.—EXHIBITION HALL, GAS APPLIANCE EXPOSITION, CHICAGO.

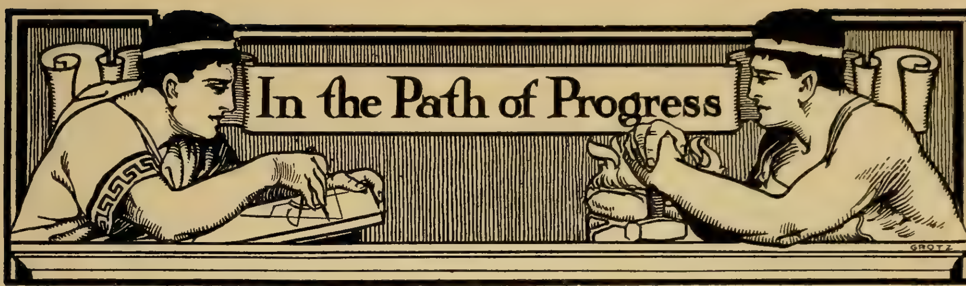

FIG. 3.—GAS ILLUMINATION IN SOUTH AFRICA.

have not been developed; and it is most certain that a wide and profitable field awaits the introduction of such an illuminant for commercial purposes. One of the most noticeable features was the entire absence of ornamental lighting fixtures, with special reference to glassware; as the lighting industry is a very important factor in every city, it is regretable that there was such a poor showing at the convention. Glassware particularly has been sadly neglected, this fact being clearly evidenced to the local gas company, when it was found necessary to have special glassware made to order for use in the offices of the company, so that the best gas illumination could be had."

We do not by any means intend to give the idea that the convention and exposition was a failure. On the contrary, it was unquestionably the most successful effort that the gas interests have yet made along these lines, and will amply repay for the time and money expended in the results obtained by way of public interest and education. The Illuminating Engineer desires to see every illuminant pushed forward to the utmost limits of its possibilities, and to this end believes that the Commercial Association and the Institute should permanently unite, and that the annual convention and exposition should in every respect measure up to the magnitude of the industries represented and the opportunities which it offers for attracting the attention of the public. A splendid start in this direction has been made; let the good work go on.

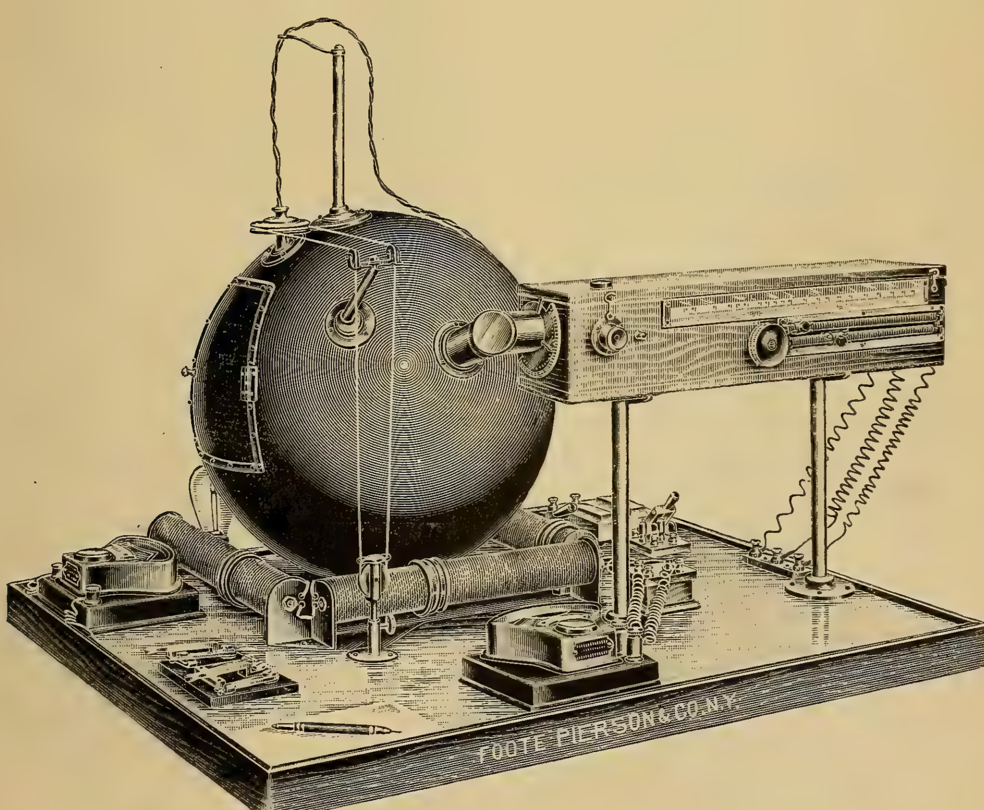
It is surely a most curious anomaly that we should have to leave the city of Chicago, whose particular boast is its progressiveness, and go to the limits of "darkest Africa" to find an example of what may be done in spectacular lighting with gas. The South African Lighting Association, Ltd., is the title of the gas company doing business in Port Elizabeth, Natal, So. Africa. The illustration, Fig. 3, shows a night view of the company's show room. The outside lamps are of 800 c.p., using high pressure gas, the additional pressure being supplied by a small gas engine. The letters of the sign are six feet high, and are formed by inch gas pipes, with flame burners, by two types. We are indebted to the *Gas World,* London, for this information.

The use of gas-flame torches as a part of the spectacular lighting during "Old Home Week" in Boston a year and a half ago was probably the most impressive feature of all the numerous lighting novelties provided, and furnishes another example of what might be accomplished along these lines by the use of gas.




## The Globe Photometer (Integrating Sphere)

The desirability of a photometric instrument which should give the measure of the total flux of light (mean spherical candle-power) by a single direct reading has long been recognized, and attempts have been made at different times to solve the problem. Probably the earliest of these was Prof. Blondel's "lumen meter." Later, Professor Matthews worked out with rare skill his integrating photometer, which has come into considerable use in this country. The latest and most successful apparatus of the kind, however, is what was called by its German inventors the "globe photometer." Briefly described, this photometer consists of a spherical shell of metal given a dead white coating on the inside. The light-source to be measured is placed within this globe, and the measurement is taken by determining the intensity of illumination on a small segment of the surface. The mechanical conditions introduce certain errors which have to be compensated. When




INTEGRATING SPHERICAL PHOTOMETER.

these compensations, which are made once for all, have been carefully worked out, the action of the instrument is very reliable.

An instrument of this principle suited to the measurement of electric incandescent lamps is now regularly offered for sale by Foote, Pearson & Company, New York.

The general construction of the instrument is shown in the accompanying cut. It consists of the sphere arranged for receiving the lamp, and a Sharp-Millar photometer for making the readings. The two are mounted on a base upon which the necessary electrical measuring instruments are also placed. By this instrument it is possible to measure not only the mean spherical candle-power, but the mean horizontal, and the candle-power in any direction, as well.

With such an instrument available, and the accuracy of its measurements assured, there is no longer the slightest excuse for clinging to the old scheme of horizontal reading in the commercial rating of electric lamps.

## A New "House-Organ"

*Juice* is the title of a "house-organ," the first number of which made its appearance last month, published by the Pettingell-Andrews Company, of Boston. The leading article treats of the theft of electric current, and is worthy of place in any technical journal. It is illustrated with wiring diagrams showing various means of "beating the meter." Every wireman and electrical contractor should have this very valuable article. A page has been set apart for questions, communications, etc. The publication is of 12mo. size, 16 pp. and cover; is beautifully printed and illustrated, and generally one of the most pre-possessing publications of the kind which comes to our office.

## For the Man from Missouri

When a prospective customer says, "It is all very well for you to tell how much less current these new lamps take than the old ones, but I'm from Missouri—you have got to show *me*"—what are you going to do about it?

That is where you flash your Tungstometer.

This is a little measuring instrument, which is much simpler and easier to manage than its name. Briefly described, it is a sort of universal current-meter, pocket size. The illustration gives a very good idea of its size and the manner of using it. As will be seen, it consists of a small ammeter with an attachment plug at one end and a socket at the other. This meter will read currents up to 1.5 ampere and to 250 volts, either direct current or alternating current of 60 to 140 cycles. By the use of the computing scale, shown just below the dial, the wattage can be easily determined.

TUNGSTOMETER.

Besides serving as a demonstration instrument, it is also useful in measuring the current consumption of tungsten and other lamps that are to be burned in series. The scale is so divided that it can be read directly in milamperes, thus giving a combination of watt and milampere readings which permits of extremely wide application.

The instrument is for sale by the Central Electric Company, Chicago, and is listed at $14.

# Foreign Items

By J. S. Dow.

### Illumination

The Lighting of Some Reading Rooms, by P. Blagg (*Elec. Review*, December 25).

The Lighting of Public and Other Libraries (*Electrician*, December 11).

Coming after the recent paper of Mr. L. B. Marks on the subject of the illumination of the Carnegie Libraries in New York, these articles suggest that an interest in library-illumination is being kindled in this country. The first of the two articles above is of special interest; the author takes up the method of lighting adopted in various libraries in London, criticising the results in each case. The second article deals broadly with the subject, and is short. It is pointed out that the only real test of actual illumination is a photometric reading on the actual tables themselves.

Illuminating Engineering (*Electrical Engineer*, December 11).

American Cities and Street Lighting (*G. W.*, December 12).

These two contributions discuss, among other matters, the recent remarks of Dr. Louis Bell on street lighting in his presidential address before the Illuminating Engineering Society. It is interesting to observe that the writer of the short note in the *Electrical Engineer* mentioned above, takes the view that the uniformity of street illumination in American towns (*i. e.*, main streets and side streets being equally well illuminated, irrespective of the amount of traffic passing, etc.), of which Dr. Bell complains, might be imitated to some extent in Great Britain, where the tendency is often to go to the other extreme and illuminate main thoroughfares well and side streets so badly that they appear very dark indeed by contrast.

The Street Lighting Business (*J. G. L.*, November 24).

Sechsig Jahre Beleuchtungstechnik (*Oesterr. Ungar. Installateur.*, December 5).

An interesting historical summary of the development of illumination in Austria-Hungary during the last 60 years.

The Absorption of Arc Lamp Globes, by Prof. J. T. Morris and E. G. Farrow (*The Illuminating Engineer*, London, December).

The authors describe a series of tests on arc lamp globes arising out of some correspondence on the above subject. They give a number of distribution curves for different globes and a table showing the percentage of light absorbed in each case. One point emphasized is the necessity of dealing with mean spherical candle-power in order to get a true value.

The Education of Those Concerned with Illumination, by Chas. W. Hastings (*Illuminating Engineer*, London, December).

The Illumination-Exhibits at the Berlin Exhibition of Shipbuilding, by W. B. von Czudnochowski (*Illuminating Engineer*, London, December).

A Demonstration of the Use of Holophane Reflectors (*Illuminating Engineer*, London, December).

Need We Fear the Effect of Ultraviolet Rays in Artificial Illuminants on the Eyes? by Drs. Schanz and Stockhausen (*E. T. Z.*, December 3; also *Illuminating Engineer*, London, December).

A reply to the previous article of Dr. W. Voege on this subject, Dr. Voege described experiments intended to show that the effect of the ultraviolet light in daylight and under natural conditions must be at least as great as in any artificial illuminants in ordinary use. Schanz and Stockhausen now reply in detail, upholding their contention that such light is injurious, and particularly to be guarded against in artificial illuminants, and criticising some points in connection with the conditions under which Dr. Voege's experiments were carried out.

### Photometry

ON PHOTOMETRIC STANDARDS, by J. K. Heydon (*Elec. Magazine,* November).

The author contributes a brief discussion of photometric standards of various kinds, and enters into those of the incandescent class in detail. He suggests that an improvement over previous attempts in this direction might be made by separating the heating element from the radiating apparatus. Thus he proposes to wind a platino-iridium wire over a porcelain cylinder, covered with platinum-black and therefore resembling the theoretical black-body. The wire will be heated electrically, and will bring the black body to incandescence.

ILLUMINATION, ITS DISTRIBUTION AND MEASUREMENT, by A. P. Trotter, *Continued* (*Illuminating Engineer,* London, December).

The author discusses the Harcourt and Bunsen types of photometers and gives some directions for the making of sensitive grease spots, and the correct methods of using photometers employing them.

UEBER TAGESLICHTMESSUNGEN, by W. Thorner (*Phys. Zeitschr.,* December 1).

The author describes his type of illumination-tester (see also *Illuminating Engineer,* London, June, for a description of this apparatus in English). The essential principle of the instrument consists in the comparison of the sky-brightness with the illumination at any point in the room, the former being judged by the aid of a small image formed by a lens; the brightness of this image can be adjusted by means of stops of known diameter. The author now proposes to replace the series of stops by an iris-diaphragm.

AN IMPROVED FORM OF HARRISON UNIVERSAL PHOTOMETER (*Illuminating Engineer,* London, December).

A description of a modification in the Harrison photometer, which enables the instrument to be used both for measuring illumination in a horizontal plane as well as in vertical and inclined ones.

### Electric Lighting

ELEKTRICITÄTSSTEUER, by G. Dettmar (*E. T. Z.,* December 3; December 10).

DER GESETZENTWURF BETR. BESTEUERUNG VON GAS UND ELEKTRISCHER ENERGIE (*Elek. Anz.,* November 30; Dec. 10).

Further discussion of the proposed tax on gas and electricity in Germany (see previous review). The matter has now been the subect of formal discussion at the German Institution of Electrical Engineers, and it was decided to address a protest to the Reichstag on the subject; the exact text of this appeal is given in the *E. T. Z.* (See above references.)

MODERN ARC LAMPS AND THEIR APPLICATIONS, by J. Rosemeyer (*Illuminating Engineer,* London, December).

A general description of the development of arc lamps, mainly by the Regina Company, as exemplified by the Helia, Reginula and other lamps, the author dwells on the nature of the circumstances that are favorable to the enclosed arc lamp, and describes how, by securing more complete exclusion of air from the globe, the performances of such lamps can be improved.

UEBER DIE ABHÄNGIGKEIT DER LICHTSTÄRKE UND DES VERBRAUCHES BEI WECHELSTROMFLAMMENBOGENLAMPEN VON DER ART UND UND GRÖSSE DER VORSCHALTUNG, by P. Högner (*E. T. Z.,* December 3).

A description of some experiments upon the effect of different conditions in the electrical circuit on the performance of flame arc lamps on an alternating P. D. The article is accompanied by full details of the energy consumed, the candle-power and the corresponding nature of the current and P. D. waves impressed upon the arc; one conclusion arrived at is that a choker is in general preferable to resistance in order to take up the surplus P. D.

DIE NORMALGEWINDE DES VERBANDES DEUTSCHER ELEKTROTECHNIKER UND IHRE ANWENDUNG IN DER PRAXIS, by P. H. Peris (*E. T. Z.,* December 3).

Discusses the standard regulations for screw threads, as laid down by the Verband Deutscher Elektrotechniker and their application to screw holder glow lamps. Hitherto some divergency had existed between the threads employed by different makers so that lamps and holders were not always successfully interchangeable. But it was found that the measurements of the chief firms were not very different, and complete uniformity has now been brought about.

METALLISCHE LEUCHTFÄDEN IN DER FABRIKATION UND IN DER PRAXIS, by B. Duschnitz (*Elek. Anz.*, December 3; December 13).

INCANDESCENT LAMPS, by J. Findlay (*Elec. Engineering*, December 3).

A SERIES OF COMPARISONS BETWEEN GAS AND ELECTRICITY, by R. E. Neale (*Elec. Magazine*, December).

DIE NEUEREN BOGENLAMPEN, METALL-DAMPF BOGEN (*Z. f. B.*, November 30; December 10).

THE QUARTZ MERCURY VAPOR LAMP (*Elec. Engineering*, November 26).

METALLIC FILAMENT LAMPS AND PRICES (*Elec. Engineering*, December 11).

GAS, OIL, ACETYLENE LIGHTING, ETC.

HIGH-PRESSURE GAS IN FLEET STREET, London (*G. W.*, December 12; *J. G. L.*, December 1, 1908).

Describes the alteration now being carried out in this important street in the city of London, where the old lamps are to be replaced by Keith 1500 candle-power sources, supplied with gas at a pressure of about 55 inches; this will be capable of being increased to 60 in. in order to control the lighting up and extinguishing by temporary pressure increase in the usual way. A more recent letter to the *Gas World* urges the merits of self-contained lamps of the Chipperfield type, which are independent of extraneous pressure raising devices, and can be applied to an existing system without altering the pipes, etc.

DIE BELEUCHTUNG DER KÖNIGSTRASSE IN STUTTGART MIT STARKLICHT, by E. Göhrum (*J. f. G.*, November 21).

Describes the arrangement of the Pharos and Selas lights running on pressures of 1400 and 300 mm., respectively, which have been introduced into one of the main streets of Stuttgart. It is of interest to note that the mantles are said to be renewed every 150 to 200 hours.

HEATING AND LIGHTING, by J. MacGhee, (*G. W.*, December 12; *J. G. L.*, December 8).

A paper dealing generally with progress in gas lighting and other matters. The author in this case also makes special reference to the future of incandescent gas lamps provided with local and self-contained pressure-raising devices. He mentions the self-lighting mantle which is now upon the market in this country, but is hardly considered to have actually reached a commercial stage; it is stated, however, that they can be made to retain their qualities for several months. The author makes the suggestion that gas companies should endeavor to have a special expert in any town of consequence whose duty it would be to instruct and advise consumers as to the correct adjustment of burners, etc.; at present these are often neglected and prove unsatisfactory in consequence.

JAPANESE HOUSE AND STREET LIGHTING, by M. Graham (*J. G. L.*, December 8).

An interesting series of articles that have appeared in the *Journal of Gas Lighting*, describing the progress of gas in different parts of the world. It should be particularly interesting to trace the progress of lighting in Japan, where the present arrangements seem to be often very primitive, from the illuminating engineer's standpoint, but where the æsthetic aspect of the subject will probably be met very happily.

EDITORIALS, CONCERNING STATUTORY CALORIMETRY (*G. W.*, December 19).

UNIFORMITY AND QUALITY (*J. G. L.*, December 8).

THE GERMAN TAX ON GAS AND ELECTRICITY (*J. G. L.*, December 8; December 15).

THE GAS INDUSTRY IN JAPAN (*J. G. L.*, November 24; December 1).

BENOID GAS (*Oesterr.-Ungar. Installateur*, November 28).

NOTES ON AIR-GAS AND PETROL-AIR LIGHTING (*The Plumber*, November and December).

GASGLÜHLICHTBRENNER, ETC. (*Z. f. B.*, Novmber 30).

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* *Contractions used:*
*E. T. Z.* *Elektrotechnische Zeitschrift.*
*Elek. Anz.* *Elektrotechnischer Anzeiger.*
*G. W.* *Gas World.*
*J. G. L.* *Journal of Gaslighting.*
*Z. f. B.* *Zeitschrift für Beleuchtungswesen.*

# Miscellaneous News

CHICAGO, ILL.—The lighting of the Electrical Show scheme will employ 10,000 of the new tungsten lamps in arches across the aisles from booth to booth. This will make the show the most brilliant ever held in Chicago. The scheme of decoration and lighting was arranged by D. H. Burnham & Co., and cost about $30,000.

ST. LOUIS, MO.—Suits involving half a million dollars are to be filed against the Union Electric Light & Power Company by members of an organization formed to collect rebates from their paid bills of the last five years because of alleged discrimination in rates between them and other consumers of electricity. William Fay, formerly connected with the Union Electric Light & Power Company and actively engaged as electrical engineer for the various lighting concerns of the city for twelve years, is directing the suits and is obtaining assistance from many business houses. Secretary H. Spoehrer, of the Union Electric Light & Power Company, claims that all contracts made since the adoption of the new schedule in November have been on the same basis of rates. He admitted that some old contracts not yet expired might be different from some now in effect, but he said the company was adhering religiously to the schedule.

NEW YORK.—The Public Service Commission has issued orders to all electric light and power companies, effective January 1, prohibiting any discriminatory or preferential rates for light, heat or power, and compelling the companies to file with the commission and display in their offices full schedules of rates charged thirty days before such rates are to become effective.

These orders are expected to bring about wholesale changes and corresponding benefits over affairs encountered by the consumer of electric current now. The order aimed at preferential rates provides that no electrical corporation shall collect or receive from any customer, by any special rate, rebate, drawback or other device, any greater or less compensation for electricity or any other service than it collects from any other customer for a like service; nor shall it give any undue or unreasonable preference or advantage to any person, corporation or locality; nor shall it vary its rates from those filed with the commission. The only exceptions to this are the City and State of New York.

OMAHA, NEB.—Omaha will have another electrical show this year, the time having been fixed for May, at the Auditorium, by a number of the leading electrical contractors and electrical supply merchants of Omaha and Council Bluffs. An organization was perfected which will be incorporated at once to handle the show. It will be called the Omaha Electrical Show Company and the stock will be held largely by the dealers in Omaha and Council Bluffs. The electrical show held last May was a success even beyond the expectations of the men who promoted it, and with the experience of last year and the confidence which success always brings with it, these same Omaha men feel confident that they can far excel last year's show in every respect.

WASHINGTON, D. C.—Senator La Follette has introduced a bill in Congress to create a Public Utilities Commission for the District of Columbia. Under the terms of the bill, a committee of three is to be appointed, which shall be an independent body. The Commissioners are to judge not only the reasonableness of the charges for service, but will also determine the adequacy of the service furnished by these public service corporations. The District Commissioners will be entirely relieved from the work of regulating all public concerns, and they will in no way be connected with the administration of the new board. Powers necessary to enforce their regulations will be conferred upon the new commissioners, whose salaries are to be $5000 each. In addition to prescribing the qualifications of the three officials. Senator La Follette directs that one must be a civil engineer, one must have had experience with the business of public utility corporations, and the other must be a lawyer. Not more than two of the commissioners must be residents of the District at the time of their appointment.

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## *Contents of This Issue:*





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# *The City De Luxe*

"God made the country and man made the town."—COWPER.

*Man is a gregarious and social animal. He loves the company of his kind. From this instinct has arisen the city and civilization.*

*The first purpose of the city is utilitarian; mutual protection against common enemies, and the economies of a division of labor are its elemental principles. As the first of these purposes becomes less important, and the second becomes the dominating motive, the city provides for those functions which pertain to the leisure part of life, and so in the end becomes the most finished and complete embodiment of man's creations.*

*The American city is now rapidly merging from the first state of its evolution; and the feeling is rapidly taking root that our cities must be something more than shelters for enormous aggregations of humanity collected together merely for the purpose of better carrying out trade and barter, and the infinite division of human labor. They must be places to live in as well as to work in. They must not only be hives of industry, they must supply facilities for recreation and the enjoyment of the artistic and the ideal as well. Usefulness should no longer be an excuse for ugliness.*

*The streets, being the common property of all the citizens, should receive first consideration in the genesis of the "City de Luxe." Good pavements, good transportation facilites, and good lighting are the three essentials; and the last is by no means least. The half-lighted thoroughfare and the street lighted only by beacons is unworthy of any city in this, the most powerful and wealthiest nation of the world.*

*We are not poor; we can afford the best that there is, especially of those things which we can produce ourselves, and surely lighting is among these. Darkness is a measure of parsimony comparable to that of the miser who hoards his gold at the expense of food.*

*The city is but a collection of individuals, and can do collectively what the majority do for themselves individually; and what individual to-day sits in darkness by reason of the cost of light?*

LIGHT UP AND KEEP LIGHTED UP!

E. L. Elliott.

NEW STREET LIGHTING, NEWARK, N. J.

# Spectacular Lighting in Newark, N. J.

The desire for the newer and more attractive street lighting seems to have become epidemic The latest city to put the idea into practice is New York's prosperous and progressive neighbor, Newark. The installation recently put in, a general view of which is shown in Fig. 1, is remarkable as being the first case of the regular use of flaming arcs for street lighting in this country. The installation extends over the five blocks of Broad Street, which is the very heart of the shopping and business district. The street is 85 ft. from curb to curb, and the lamp posts, a detail of which is shown in Fig. 2, are placed about 100 feet apart, along the curb line on either side, each post supporting a single flaming arc lamp. At intervals, low arches of incandescent electric lamps span the street. The illumination is practically uniform, of high intensity, for exterior lighting, and the mellow color of the light from the flaming arcs, which harmonizes perfectly with the carbon filament incandescent lamps, is exceedingly pleasing and comfortable to the eyes. On a dark night, when the sky is by contrast perfectly black, the effect of the arches of lamps is to convert the street into the appearance of a long hallway.

That spectacular lighting is a profitable investment, either for a municipality or private citizens, is a proposition whose truth has been often reiterated in these pages. On this point it is interesting to note that *Printers' Ink,* a journal devoted to the interests of advertisers in general,

is alive to this fact, as shown by the following article in a recent issue:

Advertising a Business Street.

When several streets in a city dispute title to the "leading business street," the matter becomes very important indeed to merchants. Location means a great deal—it sometimes means the balance between their success or failure.

For many years merchants have been content to accept the accidental course of events and drift of public opinion as to which street is the leading business street, drawing the most of the public's trade. They have dutifully followed where the public led—though the public was itself often led by mere chance and custom or tradition.

But that was the old way. A number of progressive merchants are waking up to the fact that advertising is a lever which will influence public opinion not only about trade-mark names and store policies, but also about the business streets of their city.

The merchants of Newark, N. J., are certainly learning surprising things about advertising just now. For many years the merchants of North Broad street have enjoyed an almost unquestioned supremacy as a business section. The department stores built there, and the business men regarded the fact that North Broad street was the business center of the city as immutable, like the laws of the Medes and Persians. They never for a moment questioned North Broad street's title.

TYPE OF FIXTURE FOR FLAMING ARC LAMPS.

Something, however, stirred up the merchants of the other streets of the city. They rebelled against the growing popular idea that if you went down town to shop, you could get to the best stores if you patronized North Broad street.

The South Broad street merchants stewed over the situation for a number of months and finally organized the South Broad Street Merchants' Association. They agreed that it would help much if South Broad street had better lighting. They got a special rate and strung many arc lights on the street. Then they planned an "opening night."

That was how they first used advertising. They advertised the opening night jointly. It was a big success. They saw that advertising was the real key to the situation, and they took whole pages in the newspapers, which they filled jointly with ads, under the general head of "South Broad Street Merchants."

The proof of success was the fact that the North Broad street merchants grew alarmed and organized an association also and planned to advertise.

But the game is just beginning to get interesting. A few evenings ago the West Market street merchants got together, and the *East* Market street merchants are putting their heads together also! It looks as if there will be a very entertaining game of chess and checkmate in Newark, to the profit of Newark newspapers and the city, before the situation will settle. . . .

# Indirect Illumination

By Albert J. Marshall.

Only a few years ago the use of exposed light-sources, regardless of their intrinsic brilliancy, was the rule rather than the exception, and this practice is still much in evidence. Since the commercial advent of sources of higher intrinsic brilliancy, however, and the coming of new ideas and theories in the use of artificial light, this practice has been the object of much adverse criticism. As a result, there has been marked progress in the elimination of this fault. The simplest means, namely, the use of diffusing shades, was naturally first resorted to. Seeing the benefits of this method, it is not unnatural that some should be found to advocate carrying out the theory to its extreme limits, *i. e.*, of entirely removing all light sources from the field of vision. This latter method constitutes what is generally known as "indirect lighting."

This method is carried out in two general ways. The one consists in concealing the light-sources, with their reflectors, behind a cornice or projection running around the side walls of the room slightly below the ceiling. In this method the junction of ceiling and side wall is usually blended into a curve, or "cove," which furnishes a diffuse reflecting surface. The other method consists in placing the light-sources on supports attached to the ceiling, in the manner of the ordinary chandelier, but reflecting the light onto the ceiling instead of directly out onto the space below. In either case the cove or ceiling becomes the effective light-source, illuminating the space below by diffuse reflected light.

Particular attention has been attracted to this latter method of late by the commercial exploitation of what is claimed to be a new system worked out on scientific principles. Stripped of its "talking points," the system is nothing more than the old, old scheme of putting a lamp in an inverted opaque reflector, and suspending it at a convenient distance from the ceiling; and its chief distinction, a degree of ugliness in appearance that alone would put it beyond the pale of tolerance for even commercial work, to say nothing of domestic use, for which it was especially recommended. The apparent endorsement of this system by those who have given some thought to the subject of illumination, and even by architects, is a curious example of the ease with which pseudo-scientific theories can be foisted upon the public when presented with the proper dress and stage-settings.

Those advocating indirect lighting have based their arguments on the theory that, all light-sources being removed from the field of vision, the eye, instead of having to encounter intrinsic brilliancies of glaring intensity, will only see the illuminated surface, which, on account of its extent, will have comparatively a very low brilliancy, and that in consequence the eye will be less strained. This theoretical advantage has been accepted more because of its novelty than from established scientific facts resulting from actual use. Personally, I am far from being convinced that indirect lighting as ordinarily provided is the best thing possible, or for that matter, even good for the eyes at all. I admit that my own experimental work with this method has been limited, and I likewise have been able to find but little authentic data of value on the subject; which leads me to believe that the endorsement of this system is based rather on information than fact, and that a great deal more unprejudiced experimental work must be done along these lines before reliable conclusions can be drawn.

My experience with indirect lighting—and I now speak chiefly from a physiological point of view—has been anything but satisfactory. I have carefully observed some of the more prominent examples of such installations in this country, and find that, with very few exceptions, the eye becomes fatigued much more rapidly than when called upon to work under lighting systems where well-diffused direct illumination is used. Furthermore, this fatigue is of the lasting sort, *i. e.*, after spending a few hours in spaces lighted indirectly, it usually takes

several hours for the eyes to become free from pain and the irritating after-effects. I have in mind a public hall in one of the New England States indirectly lighted by the cove method, which I was compelled (I say compelled, for I would not have tarried after feeling the annoying pain in my eyes if I could have consulted only my personal comfort) to remain about three hours, listening to a discussion on the subject of artificial lighting. After leaving the hall I went to my hotel and remained in a darkened room for the rest of the evening, so that my tired and aching eyes might have a much-needed rest.

Another example may be found in the city of New York, where, in a building largely devoted to the advancement of science, there are several assembly rooms lighted by a combination of the cove and inverted reflector methods. I have had occasion several times a year to attend meetings held in these rooms, and while the subjects presented and discussed are usually of much importance and therefore of interest to me, yet I look forward to having to spend an evening there with anything but pleasure. I have also noted, on many occasions, the apparent unconscious effort on the part of some of my co-sufferers to protect their eyes from the effects produced by this system of lighting. It is not an uncommon thing to see a number in the audience shading their eyes with their hands, and others rubbing their eyes, indicating that their eyes are protesting against the conditions to which they are being subjected. The lighting installations in these rooms, however, can be more easily tolerated than in the first mentioned case. This, I think, is partly due to the fact that the eye may derive some comfort from resting itself on the lighting fixtures; sounds odd, perhaps, but nevertheless seemingly true.

This article affords me an opportunity of publicly expressing my views regarding the use of indirect lighting in wards of hospitals. When used in such cases sufficient intensity is generally produced to enable books and newspapers to be read by the patients lying in bed; an intensity, we may assume, in the neighborhood of two or three foot-candles. This intensity of illumination, understand, is obtained on a plane approximately level with a person's eyes while lying in bed; the intensity on the ceiling or side walls must necessarily be somewhat greater. Now, a person lying in bed and endeavoring to read a book under these conditions finds no dark background against which to rest his eyes, for usually the ceiling and side walls are brighter than the paper in the book which he endeavors to read; and no matter at what angle the book is held, a similar difficulty is encountered. The result is an intolerable fatigue of the eyes. There is something further to be considered; a number of patients, owing to the nature of their illness, are not able to read, and they are therefore usually compelled to lie on their backs and look at the highly illuminated ceiling and side walls; perhaps unconsciously ever trying to find some place upon which to rest their weary eyes. The use of indirect lighting, and the doing away entirely with exposed light-sources of high intrinsic brilliancy, in some classes of service is doubtlessly of value, but surely the results obtained in hospital wards and similar places leaves much to be desired.

Inasmuch as I have criticized this system so vigorously for this purpose, it will be in order for me to offer a suggestion for improvement, so here it is: I recommend that a general illumination be obtained, perhaps by indirect means, of a very low intensity—just enough illumination to be able to see one's way about; then use adjustable brackets and equipment at the head of each bed for local lighting. By such a scheme the patients will have ample illumination for reading purposes, and the illumination produced by these adjustable brackets will also be sufficient for use in the dressing of wounds, etc., where something more than two or three foot-candles intensity is needed.

There are, of course, some examples of indirect lighting which are exceedingly meritorious. I have in mind a very large space in the city of Washington where this method is resorted to with considerable success; but the conditions surrounding this installation are so vastly different from what might be termed average conditions, that the results are hardly comparable.

Owing to the uniformity of illumination

obtained in a room lighted wholly by indirect means, the eye is compelled to receive at all times illumination of practically equal intensity, the results being that the eye, unable to materially change its focus, is tired much in the same manner as our bodies become tired from holding one position too long. Changing the focus of the eye exercises the muscles of that organ much as the muscles of our body are exercised when we move about. Therefore, if a room is lighted in such a manner as to cause different intensities of illumination, ofttimes spoken of as light and shade, the eye can very easily, by looking at these various points, exercise its muscles, thus largely eliminating eye fatigue.

It will be remembered, perhaps, that uniform illumination was one of the sought-for ideals when the practical use of artificial light began first to receive general attention. Uniform illumination, in some classes of work, is highly desirable; but there are many cases where absolute uniformity is not only unnecessary but undesirable. In most cases light and shade are essential; and strange to state, it is largely in such spaces that most experiments with indirect lighting methods have been tried, with the result that the treatment of rooms so lighted appears flat and anything but effective. It has been argued that indirect lighting rivals daylight, owing to the complete diffusing of light rays. It should, however, be borne in mind that daylight is generally obtained from windows having definite location, and in spaces so lighted, light and shade are usually in evidence.

There are two general cases in which the weak points of indirect illumination are reduced to a minimum. One of these includes all classes of interior lighting where sharp vision is not required. Auditoriums of almost every class fall in this category. In such cases the intensity required is so low that it would not produce the eye-strain resulting from the intensity required for close eye work. The illumination of a theater during the performance, which is generally the result of indirect lighting from the stage, furnishes a good illustration of this kind.

The other possibility for indirect lighting includes cases where definite shadows are not only unnecessary, but more or less objectionable. The most conspicuous and only important case of this kind is that of draughting-rooms, where the object viewed is a flat sheet of paper, and shadows of the instruments are confusing if at all distinct. In such cases the objectionable feature of rays meeting the eye from a high angle can be overcome by the simple expedient of wearing an eye shade, which should always be done where careful work must be performed under indirect illumination.

It may be interesting to note in connection with this subject some of the theories in regard to the effect of circular rooms on the mind, which, in the main, is somewhat comparable to artificial lighting where practically uniform illumination is obtained. This subject was recently discussed by the Chicago journal in which experts on mental diseases, who have made a study of conditions at the Minot Ledge Light House, attribute the unusual prevalence of insanity among the keepers to its peculiar form of structure. There is no point, they say, on which the eye may rest, so that it travels round and round in a maddening whirl. They, therefore, suggest that some means be devised for filling the curves and producing corners and angles. In support of their theory they cite instances where men who have lost their mental balance during long confinement in circular prisons have quickly regained it on being transferred to an ordinary room with corners and angles. Baron Trenck spent much of his time in prison marking marks and corners to break the circularity of his surroundings, in order to keep his reason from slipping away on the whirling and encircling walls. Gasonva, an Italian engineer, who was imprisoned in a round tower, gives much the same testimony.

It might be shown, upon investigation, that uniformity of illumination would have somewhat similar effects on the eye, and incidentally on the brain. In fact, statistics assert that the insane are unfavorably affected during long periods of unbroken sunshines, and suicides and homicides are more frequent during such periods. The matter is of sufficient importance to justify careful and more conclusive experiments.

## Practical Problems in Illuminating Engineering

# The Lighting of a Large Accounting Room

By P. H. Bartlett.

The lighting of a room in which a considerable number of people are employed at clerical work is admittedly one of the difficult problems in illuminating engineering; and that a wide divergence of opinion is prevalent is evidenced by the various methods that have been tried in the solution of the problem. In general these methods may be divided into two classes: those in which a general illumination is provided of sufficient intensity, *i.e.,* from 3 to 5 foot candles, to enable the work to be done at any point in the room at desk height; and, second, the use of a mild general illumination, with individual lights for each person.

The first of these methods may be applied either in the form of indirect lighting, *i.e.,* using a white ceiling as a diffusing reflector, and cutting off the direct rays of the light-sources; or by the use of direct lighting, the intrinsic brilliancy being kept as low as possible by the use of diffusing globes. Indirect lighting is at best inefficient, and besides is not proven altogether satisfactory from the purely physiological point of view.

Direct lighting has the objection of comparatively bright light-sources in the field of vision, even when the best possible means are used for diffusing the light. Where direct lighting has been installed for this purpose, it has frequently been found unsatisfactory, and special lighting been either entirely or partially substituted. There are certain conditions, however, in which a modification of the direct method may be used to excellent advantage and without the objections that it has usually met with. These conditions obtain in the case of large rooms particularly, if they are of considerable length in proportion to their width.

The illustration of the accounting department of the Philadelphia Electric Company, as shown in Fig. 1, is an excellent example of a method of lighting a large room of this character having a ceiling of the open beam construction such as is frequently found in modern fireproof buildings.

The purposes for which this particular room is used, viz., accounting work, required an intensity of illumination of approximately five-foot candles, with the light sources placed in such a position with respect to the desks that all would have an equal intensity of illumination and that there would be no shadows on the books.

The room is 105 feet long, 27 feet wide and 11 feet 9 inches high, the ceiling being divided transversely by 24 beams. The finished beams are 10 inches wide, 14 inches deep and spaced on 53-inch centers. The room is almost entirely occupied by rows of bookkeeper's desks of standard dimensions, extending across the room with the exception of a 6-foot passage way down one side, accommodations having been made for a maximum working force of 50 persons.

The illumination of the room as at present arranged is accomplished by means of 192 20 c.p. 50-watt lamps, arranged in rows of eight on one side of each of the ceiling beams. The lamps are placed on 34-inch centers, are staggered longitudinally, and somewhat more space has been left between the last lamp of each row

FIG. I.—ACCOUNTING DEPARTMENT, PHILADELPHIA ELECTRIC COMPANY.

and the wall on the right hand or passageway side of the room, than on the left side. The lamps are installed on 45 degrees angle receptacles, and are equipped with prismatic reflectors. The lamps are controlled by 12 switches, each switch controlling a section of four half rows of lamps, thus permitting any one section of the room to be illuminated, or, any combination of these sections.

As all of the men face in the one direction, the light sources are effectually concealed from view.

The illumination on the working plane of 45 in. averages approximately eight foot candles, and on a 30-in. plane, six to six and one-half foot candles, this being somewhat higher than was originally figured, due in part to the use of 20 c.p. metalized filament lamps, instead of 16 c.p. carbon lamps, as originally contemplated.

The illumination of the room is, however, extremely pleasing, and the photograph, which was taken at night, shows the evenness of distribution and lack of shadows, characteristic of such a form of lighting.

It is by no means necessary, however, to confine this method of illumination to ceilings having projecting beams. The beams in this case are merely incidental, and were taken advantage of as shields to screen the direct light from the eyes of those working in their regular positions at the desks. The essential features of the plan consisted in placing the desks so that they all face in one direction, and directing the light by means of proper reflectors from the rear and above the heads of the occupants of the room. Rows of lamps furnished with opaque angle shades, such as are frequently used for show window illumination, would fill the purpose equally well. The method is naturally better adapted to long rooms, and is equally available for other purposes, such as typesetting, typewriting, small machine work, etc. In these cases it has the advantage of absolute protection to the eyes from direct rays, entire absence of direct reflection, while having the light-sources themselves out of the way of the workmen.

# Studies of Notable Installations

## A Modern New York Residence

There is an old adage to the effect that "half the world does not know how the other half lives," which still holds true in spite of all our cherished democracy and theoretically equal rights. This condition particularly exists in a metropolis, whether of this or other countries. How the upper class in New York lives, and breathes, and has its being is as little known by actual observation to the lower strata of society, as are the financial deals of the Wall Street magnate to the East Side saloon keeper. What do the houses of the "400" look like on the inside?

FIG. I.—OFFICE.


FIG. 2.—RECEPTION ROOM.

FIG. 3.—DRAWING ROOM.

FIG. 4.—LIBRARY.

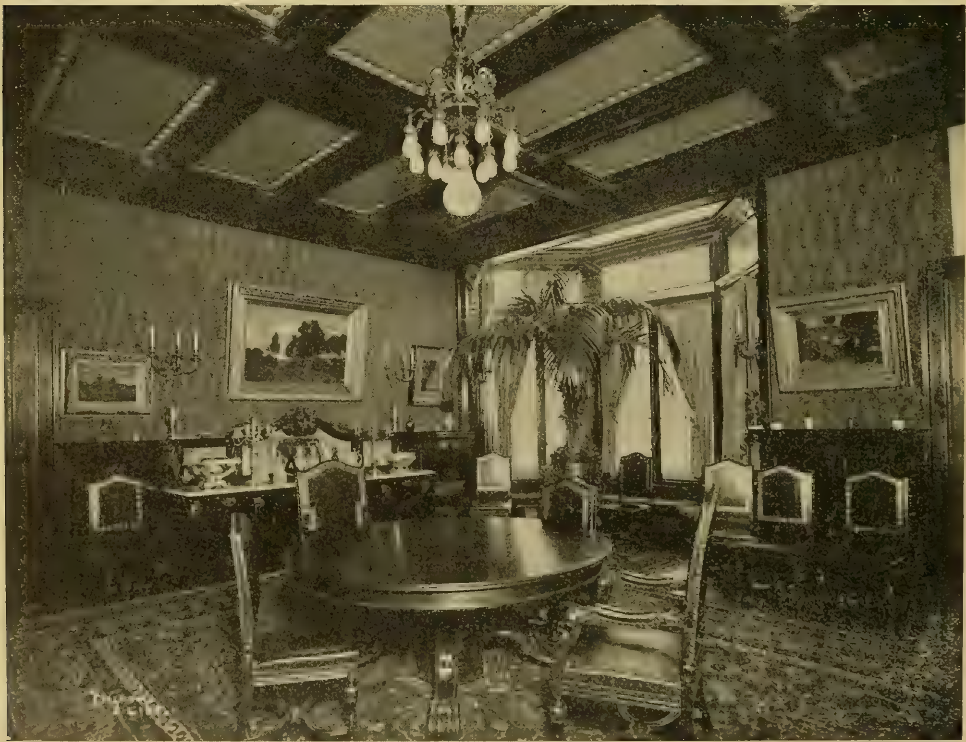


FIG. 5.—DINING ROOM.

How are they illuminated? As might be expected, they vary quite as much as the personality of their occupants. Not a few are, as things go in America, historical, which means that they were built for at least the preceding generation. These exhibit the ideas of magnificent lighting as they existed at the time; the ponderous and elaborate gas chandelier may be found in all its pristine glory. Occasionally a really fine specimen of the crystal glass chandelier or "lustre" may also be found.

In the more recent structures, however; far greater simplicity prevails, in keeping with the general refinement of taste in matters of art which has been gradually taking place, particularly since the Centennial Exposition of 1876. It is an example of this latter kind that is shown in the accompanying illustrations. The residence is not one of the "show-houses" of the city, but is the mansion of one of New York's wealthy and prominent citizens.

As this gentleman is actively engaged in large affairs, he has set apart one room in his residence as an office, which is shown in Fig. 1. The illumination here is chiefly from a central chandelier, an electric portable furnishing special illumination for the table. Close scrutiny of the illustration will show a candle-stick with a genuine candle also finding a place upon the table. Combination gas and electric brackets are likewise used. The simplicity of design of the chandelier, table lamp and brackets is the most striking feature of the lighting installation in this room. The use of the chandelier would doubtless prove trying to the eyes if continued for a considerable length of time, but the special illumination by the table lamp, with the comparatively low general illumination which would be furnished by the brackets, would give relief from this if desired. It is rather remarkable that in a mansion of this character an outlet should not have been provided for portable lamps, which would have avoided the necessity of the intolerably ugly drop-cord from the chandelier.

The reception room is shown in Fig. 2. The lighting here is entirely by brackets equipped with imitation candles and shades; the latter, by hiding the electric lamp, conceal the imitation and add enormously to the effectiveness of the illumination, both artistically and practically. The entire furnishing and decoration of the room, as will be seen, is a rigid adherence to the ideals of the French school. Artistically, the merit of the installation consists wholly in the fidelity with which the original models have been followed. That the results are highly satisfactory there is little room for doubt.

Fig. 3 illustrates the drawing room. Here, again, fixtures suspended from the ceiling are used. These consist of glass bead bowls with simple metal-work supports, suspended but a short distance below the four corners of the ceiling. The use of side brackets is retained, which, together with the exquisite candelabra on the mantle, afford what is practically a second means of lighting the room.

Fig. 4 shows a view of the library. The lighting here is entirely by sources placed about the walls, either in the form of brackets, or candelabra on the book cases, a method which has frequently been advocated in these pages. A reading lamp on the table would seem to be necessary in this room, and its absence is a little difficult to explain.

The dining room is shown in Fig. 5. The familiar "dome," which has been so much in evidence of late years, is conspicuous by its absence in this case, and in its place is an exceedingly graceful and exquisitely wrought chandelier, hung comparatively near the ceiling. The side bracket, however, is retained, as in all other rooms, but evidently for purely artistic purposes, being equipped with imitation candles, fitted with miniature electric lamps. Who will deny that the effect here is much more pleasing, where there is nothing to prevent an unobstructed view in every direction, than in cases where the ponderous "dome" is hung at the usual height—about the level of the eyes—thus obtruding itself on the vision from almost every direction?

Fig. 6 shows a bed-room. Again, the light is entirely from the side walls. However, there were some purposes which were not provided for, as is shown by the long coil of flexible cord and the large incandescent bulb hanging to one of the

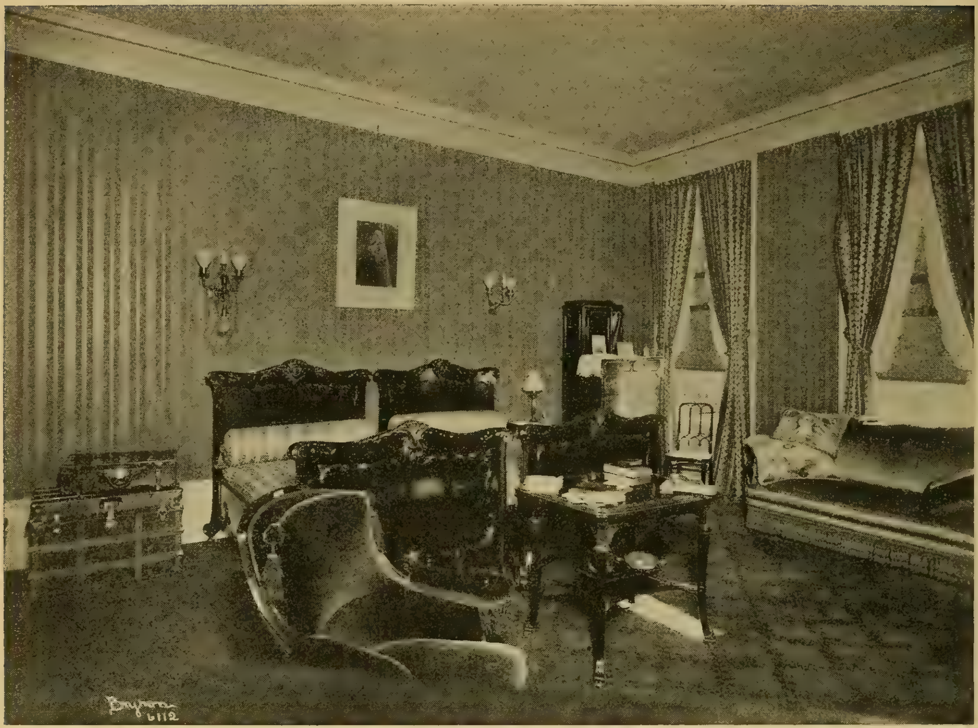


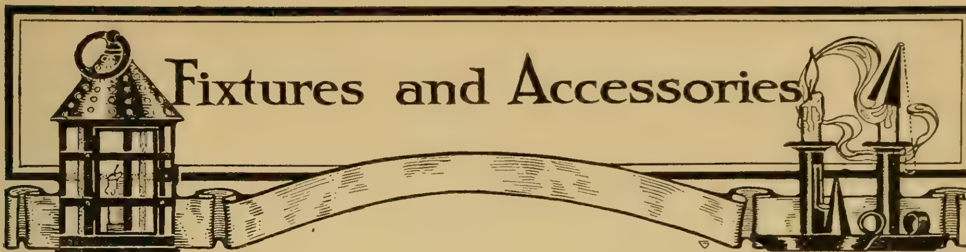
FIG. 6.—BEDROOM.

brackets. Possibly a closet was left in total darkness.

As stated at the beginning, the most impressive feature of the entire installation is its simplicity, and the general use of brackets instead of overhead light-sources. It will be further noted that in every case the light on these brackets is carefully screened with shades or diffusing globes.

It would be interesting to compare the lighting installation of this excellent example of a modern city mansion with those that were considered magnificent one or two generations ago. If we go back into the Colonial days we find the really exquisite taste of the French and English schools reproduced; but following this period, when America first began to make efforts toward finding herself artistically, the evidences that, in the search, she had lost herself in the wilderness of a mere confused elaboration of heterogeneous decorative motives, are of common occurrence. As the fixture designer of to-day is overly fond of imitating the candle with an electric lamp, so in the earlier attempts at artistic gas fixtures examples are often found of attempts to suggest, or imitate the oil lamp. Some of what might be called mediæval American fixtures are curious examples of this too prevalent mistake of assuming that art means elaboration of ornament. Overloading a fixture with metal is no new trick. The appreciation of the value of simplicity in art, however, is something which comes only with a higher state of general culture, and will always be found to decline when culture degenerates into dilettanteism. The best art is always, therefore, contemporaneous with the most vigorous and substantial periods of a nation's history.

The conclusion may fairly be drawn that the artistic beauty and harmony of a lighting installation does not depend upon the amount of metal it contains, but upon its harmony with its surroundings, and the art shown in its construction, and that good illumination with good art is a wholly compatible combination.




# The Relation of Efficiency to Art in House Lighting

In no case of artificial lighting is the artistic side of more importance than in domestic illumination. With the exception of the few rooms devoted exclusively to the practical and mechanical departments of housekeeping, artistic effects are second only to hygienic quality, and both have or ought to have precedence over mere dollars-and-cents economy.

It is universally admitted that the most serious defect of modern high-power light-sources is their glare, or in the technology of illuminating engineering, intrinsic brilliancy. This applies alike to mantle gas burners and of all forms of electric light. In order to overcome this defect diffusing globes, or reflector shades which completely screen the sources, are an absolute necessity. The use of such accessories, however, always means a certain amount of loss of light, and a consequent reduction in the efficiency; or to put it more intelligently to the layman, a soft, diffused light can be had only at a greater cost of illuminant, whether it be gas or electricity.

The relatively higher efficiency of the mantle gas burner has given it a decided advantage in this respect. The cost of producing light being so low, a considerable portion can be sacrificed for the sake of diffusion, and still leave a satisfactory efficiency. This practice has come to be very general. Bare mantle burners are now comparatively rare, especially in house lighting, either fairly dense opal shades, or reflectors which hide the mantle, being generally used.

Not the least of the advantages of the new high efficiency electric lamps is the opportunity which they offer for the use of better globes and shades for the purpose of securing the proper diffusion, as well as the production of artistic effects. With the consumption of electric current cut to a third, the sacrifice of a part of this economy for the sake of better illuminating results will be cheerfully made. Thus far the tungsten lamp has largely been used for commercial or semi-commercial purposes. Its use for domestic lighting has been given comparatively little attention, and, in fact, its use for this purpose is generally frowned upon by fixture manufacturers on the plea that "it gives too much light, and cannot be adapted to artistic treatment." They do not seem to realize that their statement in itself is a straight contradiction of terms. The higher the efficiency of a lamp, other things being approximately equal, the greater the opportunities for artistic results. While an art glass or decorative globe absorbing half of the light would be out of the question in a great number of cases with the old style carbon filament lamp, it is quite possible with a lamp giving three times as much light for the same quantity of current. The tungsten lamp can now be had in the familiar 16 c.p. bulb, and will operate equally well in the vertical or pendant position.

The use of illuminating glassware, which has more than doubled the opportunities for artistic effects in artificial lighting, is a result of the improved methods of producing light, all of which, without exception, take the form of light-sources of greater brilliancy. When the candle was the best form of light available, decorative effects were confined to the ornamentation of the supporting mechanism. The higher efficiency which has resulted from the higher intrinsic brilliancy of modern light-sources has opened up the entire field of art glass, with its limitless

possibilities, to the use of artificial light. Even the deluge of light from the flaming arc lamp is being turned to artistic account in connection with the use of art glass.

Speaking of candles brings up the question, which has elicited very widely diverging opinions, as to the artistic merit of imitation candles.

On this point a critic discussing church illumination in a recent issue of *The Illuminating Engineer* (London), says:

The illuminating engineer must consider whether the old arrangement, satisfactory as it may have been from the point of view of the illuminants available, and the prevalent feeling when the original fixtures were put up, is equally so in the case of modern light sources. At present there seems to be a need for authoritative expression of the views of the architectural profession on these points, there is a tendency, for instance, to attempt to secure the improved conditions of illumination obtainable from modern sources, and yet to imitate the relatively feeble ancient devices.

The writer then cites the use of a bank of imitation candles in which metallic filament lamps are used.

*The Builder,* commenting upon the matter, says:

As far as this journal represents architects, we can assure the writer that the imitation of candles in electric lighting is a silly and absurd sham, with no artistic principle of any kind to recommend it.

This is certainly an unequivocal expression of opinion, and it would be interesting to know to what extent it actually represents the ideas of the English architects.

# Lighting Fixtures and Tungsten Lamps

There is an old fable to the effect that the mice, being annoyed by the pernicious activity of the cat, held a convention to devise ways and means of averting further annoyance from this source; at which the sage decision was reached that a bell should be attached to the cat. While there was a unanimity of opinion as to the value of this remedy, there seemed to be some rather awkward difficulties in carrying it into practical effect. The fable strongly suggests the attitude of a certain portion of the fixture manufacturers toward the tungsten lamp. They are seriously exercised as to how this new cat, which has been so unfeelingly dropped at their front gate, may best be belled. In describing the lighting installation of a new State capital building, one manufacturer stated with much apparent satisfaction that not a single tungsten lamp was going into the building. Asked for the reason of this rather surprising statement, he replied that the tungsten lamp, especially on account of its high candle power, was entirely unsuited to the artistic effects which they wished to produce in this case. The logic of this reasoning may perhaps best be appreciated by citing an imaginary parallel. Suppose that a town were to put in a new and expensive street car system, and the chief engineer should say, with evident emotions of pride: "There is not going to be a single trolley car in the whole system; horse cars are more picturesque and in keeping with the traditions of municipal art which we desire to perpetuate." How would public opinion stand on this sort of engineering? Fortunately, in the case of the lighting installation, the fixture manufacturer's views will cease to be operative after he has been paid for his contract and the building is turned over to its lawful owners. Improved light-sources, whether in the form of the tungsten lamp, or in its still better successor which is sure to appear sooner or later, can readily be installed in place of the older and less efficient types.

This shying at the tungsten lamp and other improved methods of generating light by the fixture manufacturers recalls the early days of the electric light industry, when electric fixtures were treated as contraband, made stealthily, and exhibited only to a few trusted observers in a room kept carefully under lock and key. After all of the innumerable examples of the futility of attempting to stand in the way of progress, this attitude of the fixture manufacturer to-day is certainly one of the strangest relics of medieval conservaism. You might as well try to stop the flight of a comet in its orbit by waving a red flag as to attempt to prevent the progress of natural science.

# Theory and Technology

## The Flux of Light and the Fluxolight Paper

By Alfred A. Wohlauer.

One of the results arrived at during the convention of the Illuminating Engineering Society in Philadelphia was the recognition of the so-called flux-of-light method as a basis for the calculations of the illuminating engineer. According to accepted definition, the flux of light represents the total amount of radiation which issues from a single or a number of light sources, and is, as a rule, measured in lumens, a lumen being $1 \div 4\pi$ of the flux of one mean spherical candle, and thus equaling the flux required to illuminate one square foot with an illumination of one foot candle. Being the original quantity of light at the disposal of the illuminating engineer, the flux of light should form the starting point from which all further determinations should be derived. A knowledge of its significance, for instance, facilitates the calculation of the average illumination (flux density), for an area of any given dimension, if one employs the formula:

$$I_0 = \frac{\Sigma F}{\Sigma S} \qquad (1)$$

where $I_0$ = average illumination,

$\Sigma F$ = total flux,

$\Sigma S$ = total area.

Up to the present time, the so-called polar candle-power diagram has been the most familiar, and, in fact, the only starting point for the calculation of illumination. Such a polar candle-power diagram is obtained by means of the photometer in a well-known manner, and although the principle of the photometer and photometric measurements is based on considerations relating to the flux of light, the candle power itself represents a flux density from which the corresponding flux must be recalculated. From the polar candle-power diagram, the illumination can be determined directly, using the so-called point-by-point method, by means of the well-known formula:

$$I_P = \frac{L\phi}{h^2} \cos^3\phi \qquad (2)$$

where

$I_P$ = illumination at point P in foot-candles.

$\phi$ = angle of light ray with vertical.

$L\phi$ = light intensity in the direction $\phi$ in c.p.

h = height of suspension.

This method, which for a long while was applied almost exclusively for the calculation of illumination, and the use of which may be still desirable, at instances, is rather laborious on account of the necessary computation of $\cos^3\phi$ in connection with the other quantities. It was simplified subsequently by the introduction of special tables, charts, diagrams, calculators, etc. Incidentally, it may be remarked that the above disadvantage of the point-by-point method, consisting in tedious computations, are eliminated if one employs the formula:

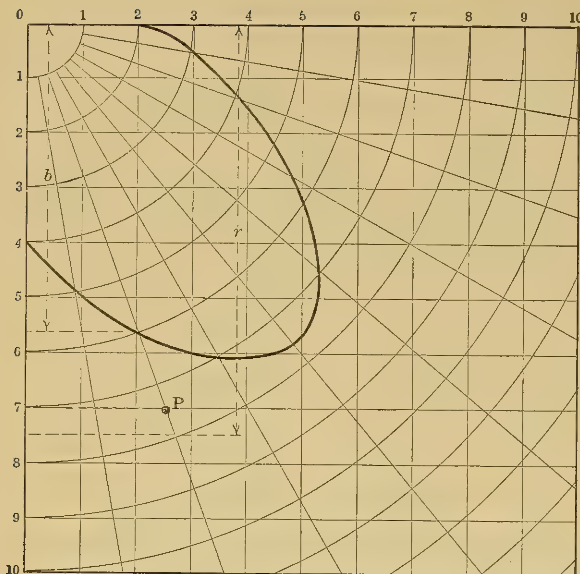



FIG. I.—SIMPLIFICATION OF THE POINT BY POINT METHOD.

$$I_P = \frac{b}{r^2} \tag{3}$$

wherein $b = L\phi \times \cos\phi$

$$r = \frac{h}{\cos\phi}$$

If the scales of b and r are not the same, as in the case of Fig. 1, where

$$\frac{\text{candle}}{\text{foot}} = e = 10,$$

then $$I_P = \frac{b \times e}{r^2}$$

where b and r are measured by the same linear units.

It is seen that in Fig. 1, for the point P,

$L\phi = 6 \quad = 60$ candles.
$b = 5.6 = 56$ candles,
$h = 7 \quad = 7$ feet.
$r = 7.4 = 7.4$ feet.

Therefore

$I_P = 1.2$ foot-candles.

While formula (3) considerably simplifies the calculation of illumination by the point-by-point method, it is impracticable to carry out the bulk of illumination calculations by this method, because it is a too slow and troublesome work to determine the illumination at numerous points of a plane and derive from these values the average illumination by means of the "illumination curves"[1] or of the "Isolux curves."[2]

The use of the flux-of-light method, as stated above, considerably simplifies the proceedings, because it is possible thereby directly and correctly to ascertain the average illumination for larger and smaller areas of a plane. However, the determination of the flux which is utilized for the illumination of a certain area is a problem which, at first sight, did not appear to be so very simple.

Various kinds of more or less complicated solutions have been suggested, which starting out from the polar candle-power diagram aimed to determine the mean spherical candle-power over a certain angle comprising the area under consideration. These solutions involve rather unusual mathematical operations which, in the well-known Rousseau[3] diagram found its first practical solution and generally adopted application, reducing solid geometry to planimetry. Basing his work on the Rousseau diagram, Dr. L. Bloch[4] introduced, for a number of standard light-sources, his so-called flux curves and flux tables, which can be used for the determination of flux values just as one uses logarithm tables. Moreover, on the same basis, Cravath & Lansingh[5] have suggested the application of the so-called polar flux diagrams which, for a certain suitable angle, simplify the determination of the flux over that angle of whatever

[1] Cravath & Lansingh: Practical Illumination. Pages 19 to 22.

[2] Dr. L. Bloch: Grundzüge der Beleuchtungstechnik. Maréchal: L'Eclairage à Paris (Paris, Baudry & Cie.). Lux: Die öffentliche Beleuchtung von Berlin (Berlin, 1896), pages 439-457. Herzog & Feldman: Handbuch der Elektrischen Beleuchtung.

[3] Rousseau: Comptes rendus des essais photométriques à l'Exposition d'Anvers, 1885.

[4] Dr. L. Bloch; *loc. cit.*

[5] Cravath & Lansingh: Calculation of Illumination by the Flux of Light Method—Paper presented at the second annual convention of the Illuminating Engineering Society.

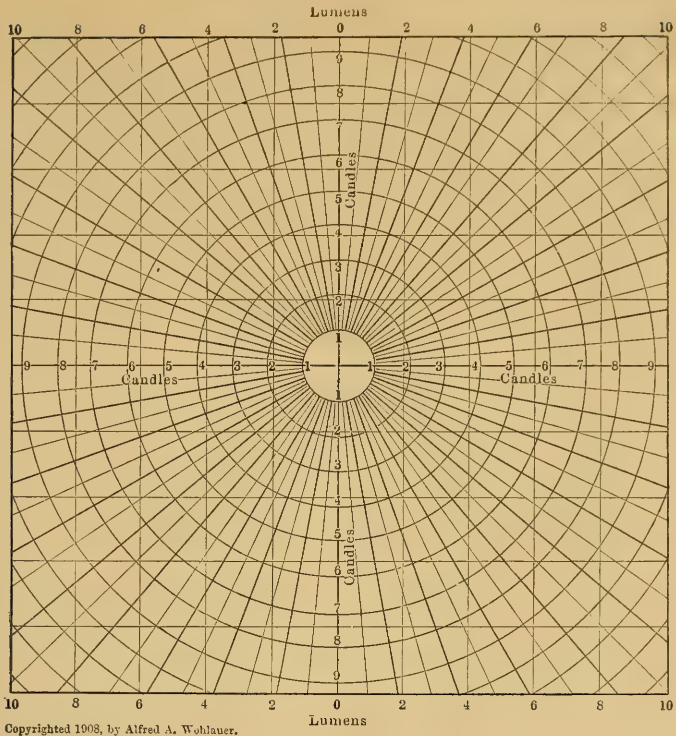



FIG. 2.—"FLUXOLITE" ILLUMINATING ENGINEERING PAPER.

shape the polar candle-power curve may be. Another original and very elegant solution was recently presented by Dr. A. E. Kenelly[1], who reduced solid geometry to linear measurements, involving only the use of rule and compass. Using the Kenelly method as a basis, E. W. Weinbeer[2] devised a slide rule by which even the use of the compass is eliminated.

The writer has arrived at a solution which renders the determination of the flux for certain angles exceedingly simple and convenient. The medium in question is a polar diagram sheet, on which rectangular cross-sections of a certain scale are superposed, as illustrated in Fig. 2. Such a paper allows one to read the values of the flux issued under a certain angle immediately from the polar candle-power diagram whenever the latter has been plotted.

THEORY OF THE FLUXOLIGHT PAPER.

Rousseau's, Kenelly's and Weinbeer's mathematical derivations have shown that the flux issued under a certain angle $\phi_2 - \phi_1$ (Fig. 3) is:

$$F_{12} = 2\pi\, L_{12}\ (\cos\phi_1 - \cos\phi_2) \quad (4)$$

where

$\phi_1, \phi_2$ = angles of light vector with vertical,

$L_{12}$ = candle power in direction, $\dfrac{\phi_2 - \phi_1}{2}$

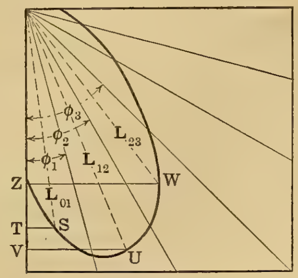



FIG. 3.—THEORY OF THE "FLUXOLITE" PAPER.

[1] Dr. A. E. Kenelly: *Electrical World*, March 28, 1908.
[2] E. W. Weinbeer; *The Illuminating Engineer*, London, July, 1908. Page 559.

It is seen that in Fig. 3:

$$ST = L_{01} \sin \frac{\phi_1}{2}$$

$$UV = L_{12} \sin \frac{\phi_1 + \phi_2}{2}$$

$$WZ = L_{23} \sin \frac{\phi_2 + \phi_3}{2}, \text{ etc.}$$

According to equation (4):

$$F_{01} = 4 L_{01} (\sin \frac{\phi_1}{2})^2$$

$$F_{12} = 4 L_{12} \sin \frac{\phi_1 + \phi_2}{2} \sin \frac{\phi_2 - \phi_1}{2},$$

$$F_{23} = 4 L_{23} \sin \frac{\phi_2 + \phi_3}{2} \sin \frac{\phi_3 - \phi_2}{2}, \text{ etc.}$$

As, however, $\sin \frac{\phi_2 - \phi_1}{2} = \sin \frac{\phi_3 - \phi_2}{2}$ $= \text{etc.} = \sin \frac{\phi_1}{2}$ if the polar diagram is divided into a certain number of equal polar divisions, there is obtained:

$$F_{01} \div F_{12} \div F_{23} \div \text{etc.} = L_{01} \sin \frac{\phi_1}{2} \div L_{12} \sin \frac{\phi_1 + \phi_2}{2} \div L_{23} \sin \frac{\phi_2 + \phi_3}{2};$$

or $F_{01} \div F_{12} \div F_{23} \div \text{etc.} = \overline{ST} \div \overline{UV} \div \overline{WZ} \div \text{etc.}$

This means that the lengths $\overline{ST}$, $\overline{UV}$, etc., represent to a certain scale the exact measure for the corresponding flux.

APPLICATION OF THE FLUXOLIGHT PAPER.

The value of the fluxolight paper for the illuminating engineer is apparent as the use of compass, slide rule and tables, as well as all mathematical calculations and operations are avoided without necessitating the introduction of any additional apparatus, except the customary and indispensable polar diagram sheet.

If it is desired to determine, for instance, the average illumination on a round table, 8 feet in diameter, using an illuminant as indicated by the polar candle-power curve of Fig. 4, it is found that, the lamp being suspended 10 feet above the table, a solid angle determined by

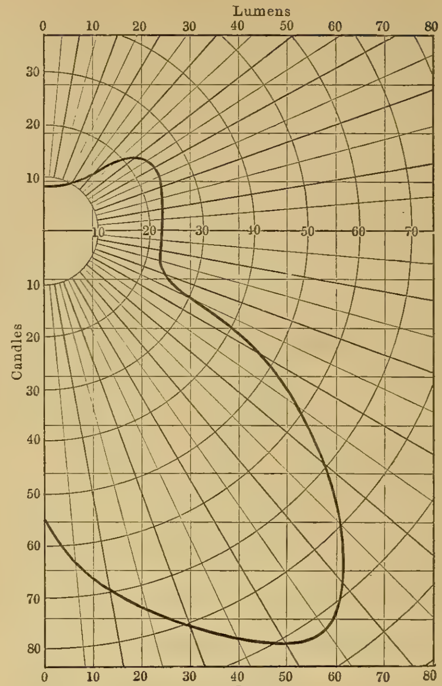



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FIG. 4.—APPLICATION OF THE "FLUXOLITE" PAPER.

$\phi = 20°$ will comprise the total area of the table. The flux over this angle is composed of the flux issuing from 0° to 10° and that issuing from 10° to 20°, and is equal 6 + 21.5 = 27.5 lumens. Dividing this value by the area of the table, the illumination is found to be equal to 0.55 foot candles.

In the very same way it is possible to ascertain the flux given out by a lamp, as illustrated in Fig. 4, between 60° and the vertical, an example quoted in Cravath and Lansingh's paper on the "Calculation of Illumination by the Flux of Light Method." Summing up the values of the part fluxes 6.5 + 21 + 39 + 58 + 60.5 + 52, the resultant flux is found to be 237 luments, while the value stated by Cravath & Lansingh amounts to 236 lumens, manifesting a fair agreement.

The application of the fluxolight paper is of value and assistance for the determination of the so-called "efficiency" of reflectors. This value representing the relation

$$r = \frac{F_1}{F_r} = \frac{\text{total flux of lamp}}{\text{total reflected flux,}}$$

is of great importance, in fact, the only correct basis for a comparison between different kinds of reflectors, though up to the present time it has been ascertained very rarely. By the use of the fluxolight paper, not more than two minutes are required to obtain a correct value of the efficiency of a reflector if the polar candle-power curve of the lamp with and without reflector are available.

The knowledge of the mean spherical candle-power of a source of light, the polar candle-power curve of which is known can also be accomplished by the use of the fluxolight paper in an extremely short time, because it is necessary merely to obtain the total spherical or hemispherical flux of the lamp by the addition of the part fluxes and to divide the total spherical flux by $4\pi$ and the total hemispherical flux by $2\pi$ in order to obtain the corresponding value. How correctly this can be done may be illustrated by applying the fluxolight paper method to an example which has been quoted by Dr. A. E. Kenelly.[1] (Figs. 5 and 6.) The theoretical value of the mean spherical candle-power, according to Dr. Kenelly is $L_s = 7.854$, the value obtained by Dr. Kenelly, according to Fig. 5, $L_s = 7.88$, while the mean spherical candle-power arrived at by the fluxolight paper method (Fig. 6) is $L_s = 7.85$.

It is obvious that the accuracy of the results can be enhanced by using a 5-degree division instead of a 10-degree, while some simplification and approximation can be introduced by a 30-degree division. In such cases, of course, the relative scale between flux and candle will vary, yet without influencing the method of using the fluxolight paper which may be recapitulated as follows: The polar candle-power curve of a lamp obtained by photometric measurements or elsewhere is plotted in the usual way, for instance, on a 10-degree fluxolight paper. The distance of the intersection of the polar candle-power curves with the 5°, 15°, 25°, etc., vectors, from the vertical axis, represents the part flux issued between 0° and 10°, 10° and 20°, 20° and 30°, etc. The sum of the part fluxes for a certain number of angles, constituting a certain total angle

[1] *Electrical World*, March 28, 1908.

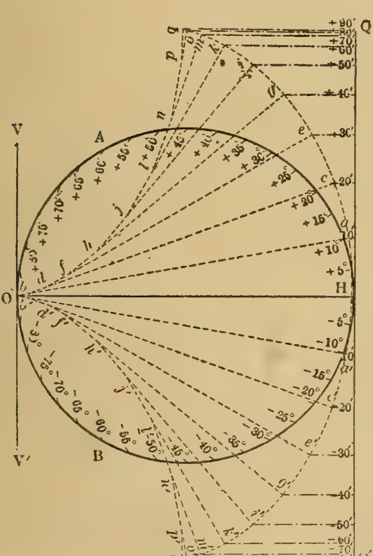



FIG. 5.—KENELLY DIAGRAM FOR THE DETERMINATION OF MEAN SPHERICAL CANDLE-POWER.

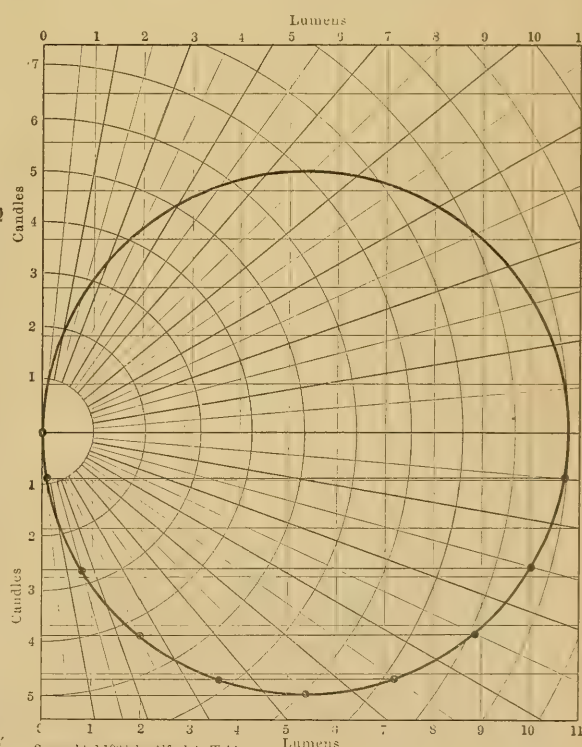



FIG. 6.—DETERMINATION OF MEAN SPHERICAL CANDLE-POWER WITH "FLUXOLITE" PAPER.

under consideration, represents the total flux given out under this total angle. This explanation, complicated as it were, will be recognized at first sight as the unwieldy transcription of one of the most simple proceedings.

# Recent Progress in the Voltaic Arc—*(Concluded)*

By Isidor Ladoff.

The substances mentioned are supposed to liberate oxygen. Straus uses for the same purpose peroxide of Manganese or directly oxygen from a container connected with the cores. These devices, if effective, have the disadvantage of materially shortening the life of the electrodes. Straus also proposed to apply the principle of aluminothermics to the arc by introducing into it aluminum.

German patent 145,811, of Nov. 18, 1902, claims the addition of Nickel to carbons. German patent 137,507, of January, 1902, claims the use of substances liberating Ammonia for the purpose of counteracting the formation of $No_2$, or $HNo_3$, in the arc. German patent 138,018, of Feb. 20, 1902, proposes for the same purpose the use of hydrate of potassium in alkaline solution, while German patent 138,019, of March 28, 1902, recommends Ammonium carbonate. H. Krautschneider and E. Raasch proposed the use of organic metallic compounds, as for instance salts of the oxalic or actic acids.

The color effect of various mineral additions was thoroughly investigated in 1894 by J. Schiff & Co., in Vienna. The following table contains the most important results of this investigation:

| | |
|---|---|
| Mg | Red-violet |
| A1 | Light green |
| Zn | White |
| Cu | Light blue |
| Fe | Reddish violet |
| Si | Reddish violet |

Arc under identical conditions somewhat longer than in pure carbons.

| | |
|---|---|
| BaO | Bluish |
| SrO | Rose |
| CaO | Red |
| FeO | Violet |
| MnO | Greenish |
| $LaO_2$ | Pure white |
| $DiO_2$ | Pure violet |
| $TiO_2$ | Blue violet |
| $ThO_2$ | Reddish |
| $CeO_2$ | Pure blue |

Arc except in $CeO_2$ in all, little longer than in pure carbons, $CeO_2$ gives a longer arc.

The oxides as a rule impart to the arc the same color as their basic element. The suboxides color the arc more intensely than the oxides. FeO for instance imparts to the arc a more intense violet than $Fe_2O_3$, MnO a more intense green than $MnO_2$. The chlorides, bromides, iodides, nitrates, and citrates, give the same color as the fluorides. The attempt to use MgO $C_{12}$ or Zn $C_{12}$, or similar compositions, always leads to negative results. It was tried to attain a white coloration of the arc by a combination of two or three different substances, but without any success, as it was impossible to find perfectly complementary spectra. In order to produce a white arc with the aid of a mineralized pencil barium fluoride was used. However, since 1906 oxide of Cerium replaced about 75 per cent. of the carbons with barium fluoride. Siemens uses nitride of thorium and Zirconium, Conradty oxides or salts of titanium or thorium, namely, 30 to 50 per cent. of the weight of the core.

Table No. 1 shows the luminous efficiency of mineralized pencils (yellow colored flame) manufactured by Siemens.

As can be concluded from the table, the light efficiency of the flame arc beginning with 6 amperes, and higher, is more favorable than in the case of pure carbons. However, below 6 amperes, the advantages of flaming arcs are rather slight as far as light efficiency is concerned.

Only Blondel's carbons allow a comparatively high efficiency even at low currents, as can be seen from table No. 2.

The efficiency of the flaming alternat-

ing current arc may be seen from table No. 3.

As to the actual cost of maintaining flaming arc lamps, as compared with same of an old and favorably known American arc lamp, we are fortunate to be able to furnish here data for a number of years.

An 18 hours' burning "Flamer" costs the consumer $40.00, and its carbons cost $12.00 per 100 pairs. An ordinary lamp costs $15.40 and its carbons $.235 per 100. The ordinary lamp will burn 150 hours, but let us assume a 125 as an average. The Flamer will then require seven trimmings to one of the ordinary lamp. Allowing five minutes for trimming in either case, at 20 cents per hour, as man's wages, gives 35 minutes and 5 minutes per week respectively, or 1,123 and 1 2-3 for labor. One carbon for the ordinary lamp trim at $2.35 each equals 2 1-3 cents. Seven times at 12 cents each equals 84 cents for Flamer for one week.

How many ordinary arc lamps will one Flamer displace? As to actual efficiency one Flamer would undoubtedly displace three ordinary ones. However, on an average only two ordinary lamps could be replaced by one Flamer.

An ordinary lamp on 110 volts takes on an average 5 amperes each. Flamers two in series on 110 volts take 4¾ amperes each. The ordinary lamp consumes then 1,100 watts, while one Flamer 4 2-3 amperes x 110 volts = 523 watts. Assume average burning hours the year around as 12 hours per day, gives 12 x 365 or 4,380 hours per year. 1,100 watts x 4,380 hours = 4,818 kilowatt hours for the ordinary lamps. 523 watts x 4,380 = 2,291 kilowatt hours for one Flamer. Let us assume the cost of power at 9 cents per kilowatt hour.

| | |
|---|---|
| Cost of 1 year power consumption of one Flamer ............... | $20.62 |
| Cost of 1 year power consumption of two ordinary lamps ........ | 43.36 |

One Flamer bought and maintained 1 year without repairs:

| | |
|---|---|
| 1 Flamer ...................... | $40.00 |
| Carbons ...................... | 43.80 |
| Labor ...................... | 6.24 |
| Power ...................... | 20.62 |
| Total ...................... | $110.66 |

The ordinary lamps bought and maintained 1 year without repairs:

| | |
|---|---|
| 2 ordinary lamps, at $15.45 each.. | $30.92 |
| Carbons ...................... | 8.52 |
| Labor ...................... | 1.04 |
| Power ...................... | 43.36 |
| Total ...................... | $83.84 |

A difference of $26.82 in favor of the ordinary lamps.

Taking the same conditions for 2 years we have:

One Flamer—

| | |
|---|---|
| Carbons ...................... | $40.00 |
| Labor ...................... | 87.60 |
| Power ...................... | 12.48 |
| Total ...................... | $181.32 |
| The ordinary lamps ............. | $30.92 |
| Carbons ...................... | 17.04 |
| Labor ...................... | 2.08 |
| Power ...................... | 86.72 |
| Total ...................... | $136.75 |

a difference of $44.56.

This coincides more or less with the opinion expressed by Mr. Marx on the same subject in the pages of the ILLUMINATING ENGINEER, about a year ago.

Actual measurements showed that it is easier to maintain an alternating arc wattage nearly approaching the direct current arc wattage with mineralized than with pure carbons. Paul L. Merconton (Eclairage Electrique, 38, 161-166, 1904) published the results of his experiments with a multiphase lamp, i. e., with a lamp containing as many electrodes arranged around the axis of the lamp as there are phases. This scheme is not new. K. Wielkens (German patent No. 105,943, of Dec. 7, 1898) and Soc. Gener. Ital. Edison di El. (German patent 138,081) of June 29, 1901, built such lamps. The latter contained three electrodes symmetrically inclined toward the perpendicular line and toward each other and three other parallel carbons. Mr. Richard Fleming patented (U. S. patent 1903) two lamps of similar construction. All these are three-phase lamps with three carbons, between the two nearest of which an arc is always maintained. Merconton claims that such an arrangement reduces the fre-

quency to be maintained and enhances the efficiency. The cooling of the electrodes is reduced by the maintenance of an arc between the carbons, all the time. The investigator used mineralized G. E. Co.'s pencil, giving yellow color. The periodic number was 17.38½ per cent and 51. in a second.

TABLE NO. I.—LUMINOUS EFFICIENCIES OF MINERALIZED PENCILS (YELLOW COLORED FLAME). SIEMEN'S CARBONS.

| | | | | | Without a Globe. | | |
|---|---|---|---|---|---|---|---|
| Amperes. | Volts. | Effective Consumption in Watts. | Diameter of Lower Positive in MM. | Diameter of Upper Positive in MM. | Average H. C. P. in HK. | Efficiency HK. per Watt. | Specific Effective Consumption Watts per HK. |
| 4 | 36 | 144 | 10 | 7 | 250 | 1.74 | 0.575 |
| 6 | 39 | 234 | 10 | 7 | 720 | 3.08 | 0.324 |
| 8 | 40 | 320 | 11 | 8 | 1100 | 3.43 | 0.291 |
| 10 | 40 | 400 | 12 | 9 | 1450 | 3.63 | 0.275 |
| 12 | 41 | 492 | 13 | 9 | 1900 | 3.86 | 0.259 |
| 15 | 42 | 630 | 15 | 10 | 2500 | 3.97 | 0.252 |

TABLE NO. 2.—BLONDEL'S CARBONS.

| | | | | | Without a Globe. | | |
|---|---|---|---|---|---|---|---|
| Amperes. | Volts. | Effective Consumption in Watts. | Diameter Lower Positive in MM. | Diameter of Upper Positive in MM. | Average H. C. P. in HK. | Efficiency HK. per Watt. | Specific Effective Consumption Watts per HK. |
| 4 | 35 | 140 | 10 | 7 | 550 | 3.93 | 0.254 |
| 6 | 35 | 210 | 11 | 7 | 1400 | 6.68 | 0.149 |
| 8 | 39 | 312 | 12 | 8 | 1900 | 6.10 | 0.164 |

TABLE NO. 3.—EFFICIENCIES OF THE FLAMING ALTERNATING CURRENT ARC.

| Amperes. | Volts. | Actual Effective Consumption in Watts. | Watts X Amperes. | Efficiency | Diameter Electrode in MM. | Avg. H. Sph. C. P. in HK. | Efficiency O. H. C. Per Watt. | Specific Efficiency Consumption Watt Per O. H. C. |
|---|---|---|---|---|---|---|---|---|
| 8 | 31 | 211 | 248 | 0.85 | 8/10 | 600 | 2.83 | 0.352 |
| 10 | 32 | 277 | 320 | 0.87 | 9/11 | 750 | 2.71 | 0.368 |
| 12 | 33 | 352 | 396 | 0.89 | 10/12 | 900 | 2.55 | 0.370 |

# Illuminating Efficiency of the Nernst Lamp

BY A. L. EUSTICE.

[In an article which appeared in the January issue of THE ILLUMINATING ENGINEER, on "Some Further Considerations of the Flux of Light Method," a table of values to be used in calculating the illumination from the various light sources was given. These values were taken from data previously published in other periodicals. Not until the forms were in press did we discover that the values given for the Nernst lamp were those whose accuracy had been criticised at the time of their original publication. In order to make the figures serviceable in the practice of illuminating engineering, therefore, we requested the Nernst Lamp Company to furnish us with their latest results. The reply of Mr. Eustice, the illuminating engineer of the company, follows.—ED.]

In accordance with your request, I submit herewith a few figures regarding the installation of Nernst lamps, and desire to call your particular attention to a few facts in connection with the figures on Nernst lamps as published in the *Electrical World*, by Messrs. Cravath & Lansingh, which you accepted as correct, and republished in your January issue.

In their original article in the July issue of the *Electrical World*, Cravath & Lansingh assigned a value of .50 to the 110 watt single glower Nernst lamp. Later, they published, in the issue of October 17, a figure of .39 and .31 for medium and light surroundings, respectively, but stated, however, that these factors were for Westinghouse Nernst, in sizes of from 88 to 264 watts. In a letter published in the November 21st issue of the *World*, they frankly admit that the figures above given—namely, .39 and .31—should apply *only to the old type 110 watt Nernst lamp*, a type unit which was in commercial service prior to August 1, 1908, and state further that for the later type of *Westinghouse* Nernst 110 watt unit, which shows an increase in efficiency of 12 per cent. over the old type 110 watt unit, a factor showing this increase of 12 per cent. should be assigned to the new 110 watt Westinghouse Nernst. Therefore, according to Cravath & Lansingh's last letter to the *Electrical World*, regarding the efficiency of Nernst lamps, they acknowledge a factor of .227 for light walls and .348 for dark walls for 110 watt Westinghouse Nernst units, when equipped with opaline ball globes.

As a matter of fact, recent exhaustive tests by the writer on commercial installations of old type Nernst lamps, which were witnessed and approved by an unbiased authority who has no connection with a manufacturing concern, indicate that the approximate value to be assigned to the old type 110 watt Nernst when operated under normal maintenance conditions, to be approximately as given below, and all equipped with alabaster glassware:

| | |
|---|---|
| Armour & Co.: | |
| Old type, 110 watt, 5″ dirty balls | .425 |
| Old type, 110 watt, 5″ clean balls | .404 |
| Old type, 110 watt, 5″ new alabaster balls | .377 |
| E. P. Charlton & Co.: | |
| Old type, 110 watt, 6″ dirty ball | .34 |
| New type, 110 watt, West. N., clean ball | .271 |
| Siegel-Cooper & Co.: | |
| 3 Gl. West. N., 9″ dirty ball | .395 |
| 3 Gl. West. N., 9″ clean ball | .276 |
| New glowers and clean ball | .240 |

Although I have given a great amount of attention to this matter, I do not feel justified, at the present time, in giving a final value to the various types of Westinghouse Nernst units, especially in view of the fact that a study of a large number of commercial installations is now under way, and as a result of these investigations, I hope to be able to give authoritative figures which cannot be questioned.

My experience and judgment, however, based upon observation of practical installations when operating under normal maintenance conditions, leads me to state, that from such information as I have at hand, and for purposes of your publication, I *do not hesitate* to recommend to any one who is figuring on the installation of lighting equipment, the same factor (watts per lumen) for the single glower Westinghouse Nernst lamp, and the various sizes of tungsten lamps with their reflecting devices.


## Psychological Effects of Light

The psychological effects of impressions received through the sense of vision have long been recognized by experimenters in this particular field of science. The charming of birds by snakes, and the control of one person by another through mesmeric influence are familiar examples of the power which vision exercises over the mind. We called attention in our last issue to some of the important physiological effects of light, aside from the mere function of seeing, and also pointed out in particular some of the disadvantages of indirect lighting in this respect. In an article appearing in this issue Mr. A. J. Marshall relates his own personal experience with this method of lighting, which confirm the opinions that we have heretofore expressed. He also considers the subject from the psychological viewpoint, and brings out some rather novel and interesting deductions with references to the effect upon the mind of uniform illumination, and of light continued uninterruptedly as instanced by a succession of sunshine, are certainly worthy of consideration. The statement has been made, based apparently upon reliable statistics, that suicides are far more common in periods of continued cloudiness and low barometer; but in locations where variations in light and shade ordinarily occur from hour to hour, or from day to day, it is undoubtedly true that continued sunshine might become equally distracting to the mind; in fact, we have realized this to a certain extent in our own experience.

On the whole, it is a pretty safe rule to deviate as little as possible from the average conditions of nature. Any arbitrary, sudden, or prolonged violation of natural conditions are sure to work harm sooner or later in some direction. If the pure theorists could have all of their ideas realized, whether along the lines of physical or social science, it is altogether probable that many people, if obliged to live under such conditions, would sooner or later go stark mad.

## The Need of More Data in Regard to Lighting Installations

What are good, and what are bad results in illumination? Wherein lie the faults of those that are bad, and the virtues of those that are good? Answers to these questions, based, so far as possible, upon ascertainable and measureable facts rather than upon theories and opinions, are seriously needed by the illuminating engineering profession to-day. The numerous glaring faults have been loudly proclaimed, and their frequent occurrence is only too sadly in evidence. Nevertheless, there are not a few installations that have been laid out without leave or license of the illuminating engineering profession that are distinctly good. Inate good judgment and sense go a long way toward securing satisfactory results in any profession or handicraft, and illuminating engineering is neither more nor less susceptible to these methods than other branches of applied science. It is the aim of science to discover not only what is good, but the laws and conditions which will insure the reproduction of such results with uniformity and certainty.

The available data in regard to lighting installations is exceedingly meagre at the present time. It is only within the past

year that a successful illuminometer has been commercially available, and naturally the use of this instrument is still comparatively infrequent. As a result, we know little or nothing, from actual results of measurement, of the improved lighting installations of the country. While it is, of course, advisable to have measurements of the results of such installations as have been planned by professional illuminating engineers, it would be equally instructive to have measurements of installations, both good and bad, that have been put in under the old regime. Not only do we need the illuminometer measurements, but accurate and full descriptions of the entire installation, and so far as possible, the opinions of different observers as to the quality of the illumination. Until there is a sufficient store of such data available, there will be wide divergence in opinion and practice among illuminating engineers, as well as laymen.

## The Tariff on Electric Light Carbons

The revision of the tariff, which is already under way, brings to light the important fact that there is an extremely high duty on electric lamp carbons. Specifically, this duty amounts to 45 cents per hundred 12-inch carbons. The belated but rapid introduction of the flaming arc lamp into this country gives additional importance to the matter. So far as we know, the entire supply of impregnated carbons suited to this type of lamp at present comes from Germany; and as one trimming only lasts for from ten to fifteen hours, the matter of cost of the carbons is a serious item in the maintenance of the lamp. It is true that, as we pointed out several years ago, the cost of impregnated carbons, figured in candle-power-hours, is less than the ordinary enclosed arc carbon; but this is scarcely an offset to their actually higher price. As in many other cases, the efficiency of the flaming arc is taken advantage of in increased light as well as diminished cost. This, of course, is a very desirable result, and one which should receive every encouragement. Thus far, the flaming arc has been used in this country only for private installations; but in Europe, and particularly in Germany, it is being largely installed for public street lighting. In Berlin, which is admittedly the best lighted city in the world, no other form of arc lamp is used.

The past year has seen a very decided movement in this country toward better street lighting, and assuredly there is no branch of the industry in which there is so much room for improvement. Anything which will tend to facilitate this improvement should therefore be encouraged. A greater use of the flaming arc lamp in street lighting is highly desirable, and to this end all legitimate efforts to reduce the tariff on arc lamp carbons to a reasonable amount should be pushed with all vigor.

Unquestionably, the duty can be reduced to one-half its present amount, and still leave ample protection to the American manufacturer. We believe that the maxim of the greatest good to the greatest number, which is the very foundation of representative government, should prevail in this case, and that the adequate lighting of our city streets is a greater good to a greater number than an excessive profit on the manufacture of carbons by American manufacturers. Not only the importers of carbons, who have only their own personal profits to consider, but civic organizations which are seeking the improvement of their respective towns in the way of better lighting, should take action in this matter and see that the exact facts are brought to the attention of the Tariff Commission.

## Illuminating Engineering With Gas

There are unmistakable signs that the gas interests are waking up to the importance of illuminating engineering. One of the most convincing of these signs is the call for illuminating engineers of experience and ability. Notwithstanding that the Illuminating Engineering Society has a thousand members, to say nothing of those who have enrolled themselves in the profession without the society, there seems to be decided difficulty in securing engineers of broad attainments, and especially those who have a practical working knowledge of gas illumination.

The gas companies themselves, and to a considerable extent the burner people, have heretofore been generally frank to

declare that illuminating engineering does not apply to gas. That it has not been applied to gas is sufficiently evident to every one. Changes in gas installations have simply been a matter of putting on mantle burners in place of the flame tips on existing fixtures, or hanging up gas arcs in place of gas chandeliers; the illumination could take care of itself. Beyond a mere change of light units there has been no conception of improving the results. There is a peculiar fixed idea that the outlets of gas pipes as originally provided in a building are absolutely unchangeable, and that therefore any improvement in the installation must be strictly limited to the use of these outlets.

The electrical contractor wisely declines to be limited by any conditions of existing wiring; in fact, he is never quite so happy as when ripping out an old installation and putting in an entirely new one; and the client takes the whole thing as a matter of course. Now, in actual fact, gas piping is cheaper than electric wiring, and there is no more reason for allowing an old installation of pipes to interfere with any desired lay-out of gas lighting units than there is for permitting similar restrictions in electric lighting.

Illuminating engineering with gas today involves questions of the best lamp or lighting unit for the particular purpose, the correct location of these units to produce the desired distribution, and the selection of the most suitable accessories; and this differs from electric illuminating engineering only in the fact that there is a somewhat larger choice of electric lamps than there is of gas lamps. Those interested in gas illumination must absolutely get away from the idea of sticking to the old outlets. Engineering consists in getting the best results with the least outlay, and it needs no argument to show that the cost of maintenance is the thing to be considered rather than the initial cost of the installation—of course, within reasonable limits. Unless the gas illuminating engineer will insist upon placing his units where the well established principles of his science demand, instead of where the old outlets may be, the electrical engineer will come in with his tungsten lamps and readiness to re-wire to suit the installation, and win the prize. There is always a best way to do a thing, and this is the way that the gas engineer must follow, regardless of imaginary or real objections; half-way measures will not suffice. If a job is worth the services of an illuminating engineer, it is worth doing according to his full directions.

## Unreliability of Photographs

The old saying that "seeing is believing" has been very generally extended to include photographs as well as actual vision. The unreliability of even the impressions of direct vision has been often demonstrated in various ways, and the opportunities for error and possibilities of deception in the case of photographs are vastly more marked. The reproduction of a photograph by the well-known half-tone process, which is almost exclusively used at the present time for printed illustrations, offers still another opportunity for both of these sources of unreliability. As a means of demonstrating or illustrating results in illumination, whether for purposes of comparison or otherwise, the values of the half-tone print is meager at the best, and a downright fraud at the worst.

In the first place, the rays of light which most powerfully affect the organs of vision are very weak photographically, and *vice versa;* thus, light-sources containing a maximum of yellow rays, which would produce strong visual effect, have little effect upon the photographic plate; and light-sources rich in violet or ultraviolet light, which produce almost no effect upon the eye, are strongly effective photographically. A photograph of an installation of arc and ordinary incandescent lamps would therefore enormously exaggerate the effectiveness of the arc light, and of course to a still larger extent the mercury vapor lamp.

In the second place, the appearance of a photograph is largely dependent upon the length of exposure, and by properly apportioning the exposure to the quality and intensity of light, practically the same results can be obtained under extremely varying conditions of illumination.

The development of the negative offers the next opportunity for variation; while making the print offers fully as many more for varying the final results. The

"stunts" that a skilled photographer can perform between the negative and the finished print would puzzle beyond measure those unfamiliar with photographic processes.

The finished print having been furnished to the photo-engraver, the latitude for change is limited only by the skill and time of the retouching artist. No change is too radical to be introduced at this stage of the process. Entire lighting fixtures may be removed or put in, details brought out or suppressed, and the general character of the picture modified *ad libitum*.

Having retouched the copy to suit the occasion, the engraver takes a photograph, from which his printing plate is engraved. After the plate has been through the regular chemical processes, it goes to the finishing department, where by local etching and tooling its effect is still further modified.

Having received the engraved plate the printer gets the final opportunity for variations. In printing from such plates the process of "making ready" is one of the arts of the trade. This consists in cutting away portions of the sheets of paper which underlie the paper to be printed where it is desired to bring out high lights, and pasting on pieces where it is desired to intensify the shadows; and even if the utmost fidelity had been maintained up to this point, the printer could very easily reverse the actual appearance so far as the general lighting is concerned.

Such being the history of the final print as it appears in the book or periodical, the wonder will be that such illustrations retain the really remarkable degree of fidelity which in many cases exists. The practiced eye can readily detect the more daring changes, such as under or overtiming the negative or print, retouching the photograph before making the halftone plate, and tooling on the plate itself.

We should in all cases remember that photographic truth is not identical with visual truth, and where photographs are used for purposes of comparison, the actual conditions under which they were taken and reproduced should be stated, and of course all retouching of prints and engraved plates should be absolutely avoided. Under such conditions photographs may serve as approximate representations of lighting effects.

## Giving the People What They Want

The late P. T. Barnum enunciated the great truth that "the people liked to be humbugged"; and every manufacturer of inferior goods, every merchant who resorts to subterfuges and misrepresentations, every salesman who bases his efforts on "talking points," and every professional charlatan, when finally run to cover, will take refuge in this assumed truism: they are "giving the people what they want."

Now, the curious thing about it all is that Barnum's dictum is not true; and the fact that he knew this himself is amply shown by the features of genuine merit which always made up by far the larger part of his "greatest show on earth"; the humbugs were merely for the sake of arousing curiosity and attracting attention. No one likes to be deceived; every one is glad to learn, and to improve his condition, when the knowledge is properly presented.

It may be easier to make a single sale by trading upon a customer's ignorance, and flattering his vanity, but when such a customer once learns the truth he is lost to that salesman; while the man who has been persuaded, even at the cost of considerable effort, to accept an improved article, or to employ better methods, is not only a permanent customer thereafter, but an advertising agent as well. The man who has made a good bargain, or has secured something better than his neighbor, is bound to let his superior acumen to be known. To educate people to accept only the best may be a slow and disheartening process, but it is a permanent investment, and once having been judiciously made, will continue to bear interest for a long time afterward. It is the unsolicited business that pays, and this kind of business comes only from that intangible thing known as reputation; and reputation comes, not from catering to ignorance and prejudice, but to producing the best and demonstrating its superiority.

These general observations apply to the manufacture and sale of lighting fixtures

and to constructive illuminating engineering with full force. When a plea is made for more artistic designs and better results in illumination, the old answer is often made: "They are not commercial; we have to give the people what they want." And this will doubtless continue until the millenium arrives. It will always be possible to divide humanity pretty definitely into those who lead, and those who are led—whether considered socially, politically or commercially; and the majority will be found on the side of those who are led.

The fixture manufacturers who keep abreast of progress in the production of light, and even push ahead of the procession in adapting their manufactures to new conditions as they arise, are bound to be in the lead. The truth of this has already been demonstrated. Progress in these days, moreover, has struck such a rapid gait that those who hesitate are more than ever in danger of being lost.

## Taxing Light

The eternal question with all civilized governments is taxation. "We are sure of nothing in this world but death and taxes," according to the old proverb, and it seems to be human nature to fight shy of both with about equal strenuosity. One of the most startling propositions for raising public revenue comes from Germany, where an attempt is being made by the government that will virtually put a tax upon artificial light. An interesting discussion of this proposed tax by a German contributor is given elsewhere in this issue.

The taxing of artificial light recalls the tax on windows which was formerly levied in France, and which was one of the measures of oppression swept away by that most fierce and remarkable of all political conflagrations—the French Revolution. In this age of enlightenment and progress, it seems almost incomprehensible that a premium should be put upon darkness, and all that it stands for physically and metaphorically, by taxing light; but while we are thus looking for the mote in our brother's eye, it may not be out of place to look about for the beam in our own. Although adroitly concealed by the operation of a municipal contract, every user of gas light in the city of Philadelphia practically pays a tax upon his light. This is brought about by the city purchasing gas from a privately operated company, and reselling it to the citizens at an advance in price, recovering the profit into its treasury. The queerest thing about it is that the citizens, instead of realizing that they are being taxed for light, apparently look upon the deal with no little inward satisfaction as a very neat and commendable scheme for capturing a portion of the ill-gotten gains of the gas company.

## Illuminating Engineering and Common Sense

A speaker at the first convention of the Illuminating Engineering Society defined an illuminating engineer as an "electrical engineer with common sense." Since that time the exploitation of common sense as a basis of engineering has been continually cropping out. A contribution to one of our contemporaries recently contained an elaboration of the theme, and a new "house organ," reviewed elsewhere in this number, also harps upon the same string.

Now, common sense, which has been made to cover many sins, as well as virtues, is a most excellent attribute for any person in any calling. In a broad sense, it may be defined as instinctive good judgment. No amount of acuteness of observation and judgment alone, however, will ever make an engineer. Engineering is the application of physical science; without a reasonably comprehensive knowledge of the scientific principles involved there can be no engineering. A closer examination of the various pleas for common sense in illuminating engineering will disclose the fact that it is generally a bogie to distract attention from the lack of technical knowledge. No one is so fully persuaded that "beauty is only skin deep" as the hopelessly plain woman; and the claimant for the superiority of common sense in engineering will generally be found woefully shy of scientific training.

# Correspondence

## From Our London Correspondent

In the management of domestic gas lighting many troubles beset the consumer, his wife, members of his family, and *ménage*. There has always been a difficulty in their understanding the A. B. C. of incandescent gas lighting; hence, the following few hints, which are not in a way new, may be of some service to the nonprofessional readers of THE ILLUMINATING ENGINEER. Before the mantle is put on, the flame should be nonluminous; if any part gives a yellow light it indicates that there is a too free passage of gas, and not sufficient air supply. Of course, the remedy is to be found in admitting more air and less gas until a perfectly nonluminous, blue flame is obtained. The outer part of this flame is the hottest, and should spread so as to heat the mantle to incandescence. One of the details of incandescent gas lighting least understood is, that the less the gas used, the more brilliant the illumination. The reason is easily explained, and should not be difficult to understand; when the supply of gas to the bunsen burner is reduced the cone of blue flame fits the mantle more perfectly than when the gas exceeds the requirements and "tails over" the tip of the mantle. The mantle must fit the burner closely, so it is of paramount importance to see that a mantle of the correct size is being used. Unfortunately it has become general for mantles to be sold by tradesmen who know nothing about their use, and who are quite unable to advise the consumer; therefore, too often mantles that are too large or too small are indiscriminately sold to the public, with the result that incandescent gas lighting is neither satisfactory nor economical. It is quite a mistake to imagine that a large mantle gives more light than a small one; unless the mantle is fitted to the flame cone of the bunsen burner the light will not be satisfactory. Again, a loosely fitting mantle will be much more affected by vibration; a certain cause of breakage and shortened life.

On this side of the Atlantic gas consumers are becoming every day more dependent upon the gas works management, and find it answers their purposes better to pay a small quarterly charge for the maintenance of their burners, mantles, fittings, etc. But this is only another instance of the domestic management shifting the responsibility and, of course, having to pay for it, instead of learning to do the work themselves.

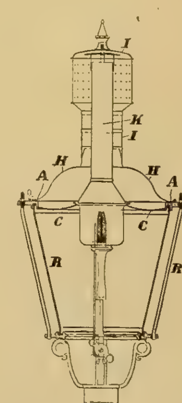



FIG. I.—GLOVER'S STREET LAMP.

We are under the impression that we have before called attention to Glover's Incandescent Gas Lamp, but we give now a more complete illustration, Fig. 1, of this specially designed street lamp; particularly because with us, public lighting by incandescent gas burners has become almost universal. Recently, in preparing a statistical return connected with the gas

undertakings of the United Kingdom we have found that all towns of importance where gas is used for lighting the streets, incandescent gas burners have supplanted the flat-flame and argand burners; at one time the argand burner was extensively used for high-power gas lighting, but it is now practically obsolete.

The Glover lantern has several novel features; the invention consists primarily in suspending the glass globes surrounding the incandescent mantle from the reflector, and loosely attaching the intensifying tube or chimney, shown in the illustration, at its upper end to the hood and frame of the lantern, so that the bottom edge rests on the glass globe and makes, practically, an air-light joint.

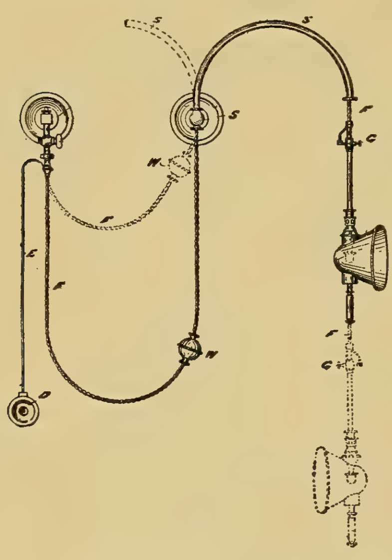


FIG. 2.—GAS LAMP FOR SICK ROOM.

Gas is daily being adapted for all sorts of purposes, independently of its uses for general illumination. Quite recently Mr. J. H. Hill, the engineer of the City of York Gas Works, patented a gas lamp for the sick room, shown in Fig. 2. It will be noticed that the flexible gas supply F, which is most efficiently provided by using metallic flexible tube, carries a counterbalance at W and passes to the burner through a swing guide tube, S. The inventor prefers to fit the burner with a pneumatic switch D. E. G., the connection of which is carried through the flexible tube F. The arrangement illustrated shows the lamp adapted to serve two beds. The burner may be drawn up or down and placed to or away from the patient, as desired; and when a reflecting hood is used, the light may be screened from the patient until such time as it is actually required. The primary use for which this lamp was invented was in connection with medical "light treatment," gas being the luminant instead of electricity.

Some years ago the penny-a-liners of our cheaper papers went mad for a month or two with reference to the finding of natural gas in Sussex, one of the lovely garden counties of England. Artificial gas, they told us, would soon be a thing of the past; the natural gas could be easily and cheaply piped to London; all the towns *en route* could draw their supplies from it; the shortening of coal supply could be watched without concern, etc. As a matter of fact, we believe it is true that natural gas was squeezed out of the earth at a village called Heathfield; a company was formed, and those thirsting for wealth parted with some that they already possessed; but the penny-a-liners' stories proved like many others to end in smoke, and natural gas in Great Britain has given out.

There may be some of your readers who will be interested in a few particulars of present day street lighting in small towns. This subject was dealt with in a paper read before the members of the Institution of Municipal Engineers. These gentlemen are engaged by municipalities to look after roads, sewers and lighting. Within the last few years street illumination has exercised the minds of all public authorities, and the particulars given in the paper before us are well thought out. Upon the question of distance of lamps, the writer suggests that the following rules may be accepted:

| | |
|---|---|
| Main streets | 50 yd. apart. |
| Residential streets | 60 to 70 yd. apart. |
| Outside roads | 90 yd. |

For incandescent lighting he mentions that efficient windproof, all copper lanterns should be selected; lanterns made of cheaper materials rapidly corrode and are costly for repairs. Considerable care should be taken to see that all standpipes and burners are fixed exactly in the cen-

ter of the lanterns, otherwise reflectors become discolored. In his own district, No. 4 Kern's are used in the main streets; residential streets are variously lit in the Welsbach Company's "C" burners, Bray's incandescent, and Block lights. Summarizing these three he prefers the "Bray," it being inexpensive and costing little for repairs. All burners are fitted with by-passes, and so stout copper wires with extra large rings are fitted to the levers in place of chains; the wires would certainly appear to be more convenient for the lamplighter. After many trials of many mantles, the writer of the paper has found the "Ironclad" to be the most economical; he gives the following particulars of mantle consumption in the worst period of the year: The average mantle consumption per lamp worked out for 1906-'07 at 5.61 mantles; for 1907-'08 at 5.66 mantles per lamp per annum.

C. W. Hastings.

London, February, 1909.

## From Our Baltimore Correspondent

The architects of Baltimore have increased their charge from 5 to 6 per cent. for drawing up plans and supervising building construction, and it is hoped that this increase will enable them to engage illuminating engineers to design lighting installations. A critical examination of public buildings, residences, stores, etc., in Baltimore will disclose few designed along scientific lines, more attention having been concentrated in ornamentation than in practical illumination; for this reason a wide field awaits the entrance of the illuminating engineer in whose hands could be placed the problem for proper solution, for none can deny the necessity for a specialist in this particular line. It therefore remains for the architect to recommend to his client the importance of proper illumination equipment, and it is through his able assistance that the subject can receive its greatest impetus.

FIG. I.—LAMP POSTS AT ENTRANCE, CUSTOM HOUSE, BALTIMORE.

The advantage of scientific illumination has best been displayed in one of our most prominent institutions, the Maryland Institute of Art and Design, which has recently been rebuilt through the generous gift of Andrew Carnegie. During the past month an exhibit has been held, where paintings by the most prominent artists are displayed; and it has been largely due to the unsurpassed illumination that the various paintings stand forth in lifelike reality, and the success with which it has been attended can be attributed to the important aid that light has given toward its accomplishment.

Since the completion of the new United States Custom House, at a cost of over two million dollars, the main entrance has been the subject of adverse criticism by those persons whose business brought them daily to the building, the general consensus of opinion being that there was an apparent abruptness entirely out of harmony with the balance of the building; this has now been overcome by the erection of two handsome ornamental posts, as shown by the illustration, Fig. 1. The posts each are surmounted by a huge torch containing twenty-four lights; they are made entirely of bronze, at a cost of $4200; they were designed by Hornblower & Marshall, Washington, D. C., the architects of the building.

Considerable surprise was occasioned by the announcement made by a representative of the Standard Oil Company that it is approaching Baltimore with a pipe line through which it proposes to supply natural gas for illuminating and heating purposes. Already rights of way have been secured through the necessary territory, and it is understood that negotiations are pending between the Consolidated Gas, Electric Light & Power Company and the Pipeline Company for the distribution of the product in this city. Failing to make an agreement, the company will invade this territory on its own account, supplying gas, it is said, at 50 cents per 1000 cu. ft. as compared with $1 for the manufactured article now supplied by the Consolidated Company.

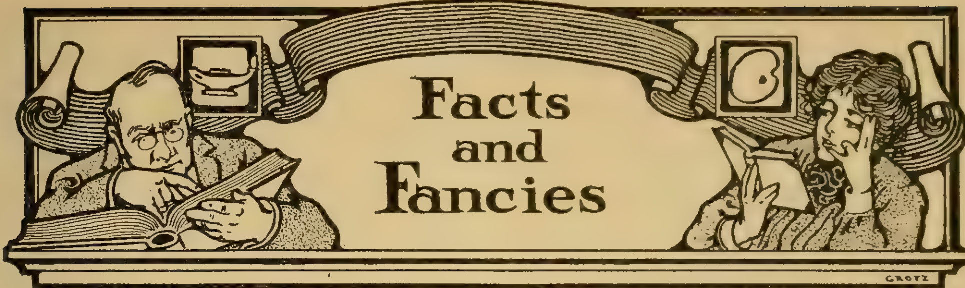
A lamp destined to replace the tungsten, with greater efficiency and a much stronger filament, is now being perfected in this city by the Grenagle Electric Company. Its inventor claims that the lamp will consume not more than ½ watt per candle, and can be used in any place that an ordinary carbon filament lamp has been used. Up to the present time only preliminary experiments have been made, which go to prove, however, that the lamp will take its place in this modern lighting age as the most efficient lamp ever placed on the market. Those interested in the manufacture of this new lighting unit are reticent of its qualities, preferring to wait until some lamps are placed in practical use; however, they are backing their confidence by strong financial assistance. Several officers of the company have recently returned from Niagara Falls, where orders have been placed for machinery and furnaces to place the plant in full operation. Mr. J. Frank Morrison, one of the pioneers in the electrical industry in Baltimore, is interested in the manufacture of this lamp.

For a number of years the Public Bath Commission have felt the necessity of proper illumination at the large lake at Patterson Park, used as a swimming pool, and have hesitated to allow bathing at night owing to the poor lighting equipment. In accordance with their demands it has been arranged to properly illuminate the entire lake, gymnasium, running track, and athletic field. All wires will be run underground, and an iron pole fixture will be used, on top of which will be placed seven 100-watt tungsten lamps in inclosed balls; there will be approximately fifty-two of these poles erected, eight of which will be placed in the center of the lake, and the balance distributed through the athletic field and running track, providing ample light for athletic contests at night.

Contracts have been awarded for the installation and the work is to be completed for the coming season. This new illumination will be a great step toward preventing accidents at night in the water, where the lights will be of sufficient brilliancy to allow the lifeguards to discern any swimmer in danger.

SYDNEY C. BLUMENTHAL.

BALTIMORE, February, 1909.




# Rubbing It In on Mentor

By Guido D. Janes.

The inhabitants of Mentor had been guying the inhabitants of Ducktown for a long while. They had laughed up their sleeves over the kerosene-illuminated highways of the latter place, and one night in October had smiled so vigorously that the wind generating therefrom strolled over to the town of Duck and extinguished all the lights. Naturally, this act of rudeness was resented, and, though four miles separated the two towns, the Ducktown folks decided to march onto the place and blow wind into all the gas mains; but losing themselves in the darkness they got their directions mixed, and the trip was abandoned.

Early next morning, Banker Benneson, of the Ducktown Savings Bank, journeyed to his place of vocation with a smile upon his face.

"What are you pleasant over," growled the teller, "I don't see how you can be pleasant over what took place last night."

"I have a scheme," was the reply; "I can tell it to you in three watt-minutes. Why not harness Homan Falls on the edge of our town, and generate enough horse-power to kick Mentor into a short circuit of obscurity?"

"I believe, Mr. Benneson, that you have burnt out a fuse."

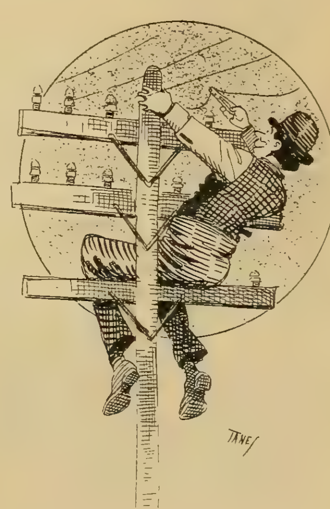
"No, I have not. I am going to finance the harnessing. We can put in turbines, and manufacture enough electricity to light our streets, houses, summer kitchens, etc.; furthermore, to cap the climax, I will make that snip of a village, Mentor, advertise us into a place of national reputation."

"How?"

"Wait and see."

Then he went to work before 10 o'clock, and by afternoon he had interested the city government, a couple of capitalists, and an electrical engineer. That was in October; in March, the water-power plant had been finished, with a registered strength of 25,000 horsepower.

All this while Mentor was looking upon the joking side of life. They made puns upon the waterpower; even going so far as to say that the "Ducks" could float around on same and generate enough electricity with their feet maybe to make a dry battery wet. These and other aspersions were hurled against the scheme, and the day it was completed, Mentor folks



CUTTING THE COMMUNICATIONS.

celebrated the event by closing up the public schools, telling jokes, and stringing across their main street a large picture of Bill Nye.

At Ducktown, however, all was different. Preparations for a novel celebration were being made, but along illuminating lines. Flaming arc lights were installed every fifty yards inside the corporation, while enough incandescent lights were sprinkled over the business center to make an ordinary size flux look like 30 cents. In fact, the whole town was being wired from one end to the other for some mysterious reason, the exact import of which no one knew but Banker Benneson. They knew he was going to get back at Mentor good and hard, but did not know exactly how. So all day long, arrayed in their good wearing apparel, they waited for the said mysterious something to take place.

At nightfall, Banker Benneson strolled out of his paid-for-residence on Peachtree Street, and going to the band-stand on High Street, addressed the populace:

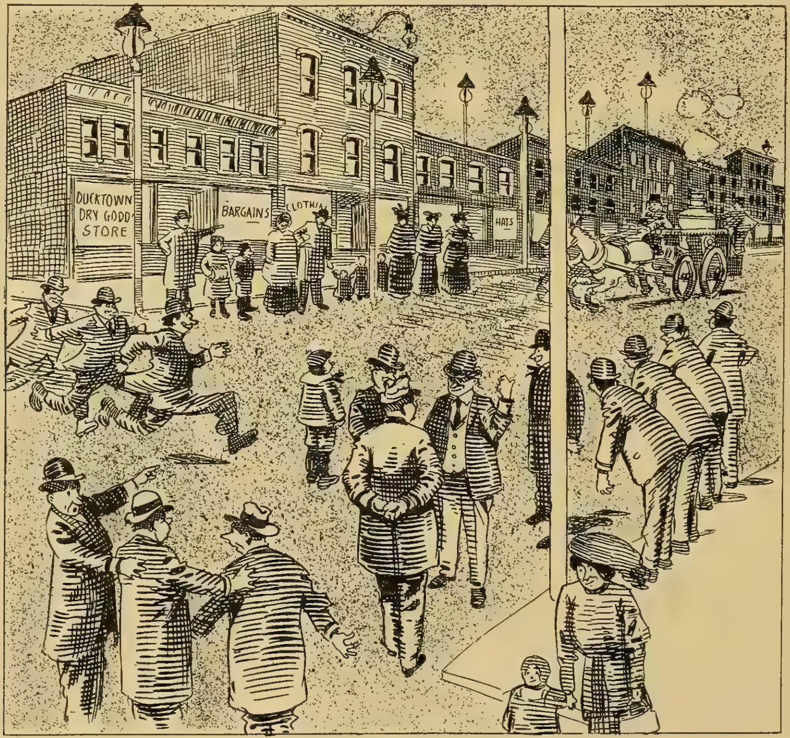
"Folks, friends, and enemies of Mentor," he said, "at seven o'clock the dynamos of the powerhouse will be cut in, and the town will spring out of the darkness, and blossom like the rose. It will spring from the age of wick into a ball of fire. It will drink in its light from the waterpower instead of the kerosene."

"But how are you going to rub it into Mentor?" asked one of his hearers.

"Simply this way: At seven o'clock every available light, arc, bulb, and electric will be turned on. While some of you are doing this others will cut all wire communications with the outer world. In other words, after seven o'clock, no one else in the world will hear from us for a time. Will you do this?"

"Sure," remarked a quantity of citizenship; and not a few of them at once procured pairs of pliers and nippers and got busy damaging telephonic and telegraphic communications.

That was ten minutes to seven, and just




THE ARRIVAL OF THE FIRE DEPARTMENT.

as the clock in the court house steeple was clearing its throat for the hour, Ducktown suddenly sprung into a sparkling and bewildering light. Thousands of small lights, hundreds of large lights imitated day time remarkably well. Some of the citizens fainted, others wept, and still others took it good naturedly. "Hurrah, hurrah, for Benneson!" cried a raft of people. "Long——"

But they did not conclude their remarks, for just then a fire-engine and a hose-cart dashed into the town. The drivers, horses and pipemen were quite out of breath.

"Where is the conflagration?" asked the batallion chief of the apparatus. "Mentor telegraphed us that Ducktown was burning down. I see it is a lie, and we have run over here all the way from Louisville. It looked like a fire all right until we got here. What in the hell are you doing with all this superfluous light? I hate to go back to my home town again, for they will guy me unmercifully. Can't you have a small fire, anyhow?"

"Just stay here, and not go back at all," remarked Banker Benneson, "our town will grow now by leaps and bounds; we will need you for a fire chief. Ship back your apparatus. If you stay we will give you free electricity for a year."

"Honest?"

"Yes."

"I will stay, then."

"Now establish communications with

"I WILL STAY, THEN."

the outer world," added the banker. "Mentor has given to the associated press a story to the effect that we were going up in smoke. Tell the associated press that there was an error made; instead of a fire, it was new electric arc lights and a new lighting plant being tested and tried. This will advertise the city, and attract many people."

"Yes, sir," replied the operator, to whom the remarks were directed; "you are the most original and progressive man in the country, Mr. Benneson."

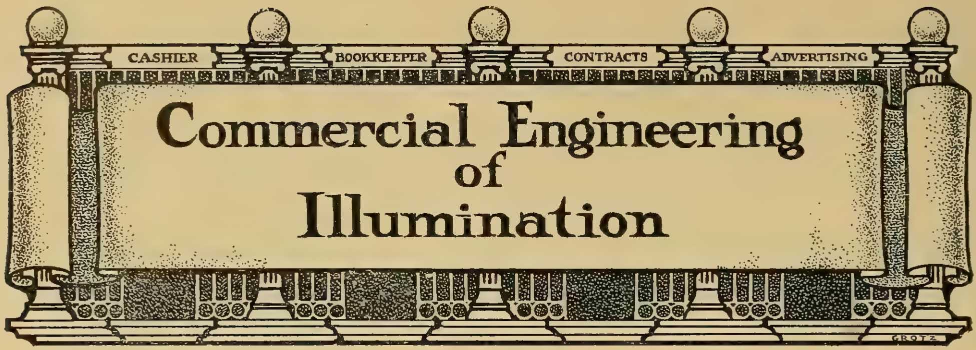
"Thank you. But I did it just to get back at that alleged town of Mentor."

## Sunshine Recorder Burns Its Record

A sunshine recorder that burns a record on a card when the sun is shining is a device recently invented in England. It consists of a metal bowl firmly fixed by means of a brass bracket in a slate base. In front of the bowl is a movable pedestal, upon the curved top of which rests a glass ball. The inside of the bowl is fitted with a series of grooves which hold the strips of card upon which the record is scored.

The instrument faces south. When the sun is shining the focussed rays char one of the strips of card, and as it travels across the horizon the burn gradually moves along with it. When the sun is hidden the card is untouched.

Trees and other objects likely to intercept the sun's rays must, of course, be avoided in placing such an instrument.—*Popular Mechanics*, Chicago.




# The Commercial Field for Illuminating Engineering

BY E. L. ELLIOTT

**(Abstract of lecture given before engineering classes of Swarthmore College)**

Engineering always implies the application of the facts and methods of science to secure a commercial end; and this holds as true with illuminating engineering as in the other departments of engineering science. In still briefer words, engineering accomplishes a given material result with the minimum of material and labor. In accomplishing this end, it is obvious that an exact knowledge of the properties and behavior of the various materials with which the particular branch has to deal, is essential, together with an equally exact and comprehensive knowledge of the methods of combining and utilizing these materials to form the finished product.

I have previously attempted to point out the salient features, materials and conditions with which the illuminating engineer has to deal, and the results which he may be expected to attain. The commercial side of the question is concerned with the opportunities offered in the general field of industry for this special knowledge and skill. A comparison with electrical engineering will afford a close parallel. Undoubtedly the majority of electrical engineers find employment with manufacturing concerns engaged in the construction of electrical apparatus and the generation and supply of electric current. Similarly, the chief field at the present time for illuminating engineers is with commercial organizations either producing lighting apparatus or illuminants—electricity, gas or acetylene. Of these three, electricity furnishes by far the largest field. When we consider that the entire electrical industries of to-day were built upon the foundation of the electric light, and that there are more than 4000 plants generating current for public sale, and some $1,000,000,000 invested in the electric lighting industry, the possible extent of the field for illuminating engineering in this one particular branch will be apparent. The largest of the central stations have already either established distinct illuminating engineering departments, or are using illuminating engineering in connection with their contract departments; and this practice is bound to extend as rapidly as competent illuminating engineers can be found.

And, right here, it will be well to emphasize the great advantage, in some cases amounting to necessity, for the illuminating engineer to combine with his technical knowledge at least an adaptability to the profession of salesmanship. In most cases at the present time the illuminating engineer connected with the central station must have the combination of tact, amiability and persuasiveness that will enable him to convince his client of the advantages of the electric light, as well as to furnish the technical skill necessary to give him the best results. While the purely theoretical illuminating engineer of unquestioned talent would have little difficulty in finding occupation, the greater demand by far is for a combi-

nation of engineering skill with what may be called the commercial instinct. Any young man having a fair degree of these two qualities need not wait long for reasonably remunerative employment, with every road of preferment open to him.

The next largest field is at present with manufacturers of various lighting appliances, such as electric and gas lamps, fixtures, lighting glassware, etc. The demand in this field is bound to expand rapidly in the immediate future. The writer has been twice called upon within the past two months to recommend illuminating engineers to corporations, who were ready to pay salaries at least as high as those paid to their general superintendents, if they could find the right man. In both these cases business experience and ability were required along with actual experience in the engineering work. The manufacture of lighting fixtures and accessories amounts to $30,000,000 annually in this country. Thus far only two concerns have definitely established illuminating engineering in connection with their manufacture. The marked success of these concerns, however, is sure to lead others to follow at no distant time. In this field mechanical, and some artistic, skill will be of greater value than commercial ability. The entire fixture business is bound to be revolutionized commercially, artistically and mechanically within the next ten years, and in this revolution illuminating engineering will play an important part. One of the largest manufacturers of electric lamps of all kinds maintains an illuminating engineering department at a total cost of $50,000 per annum. This department handles research and testing work directed toward the improvement of the company's product, as well as giving advice and assistance to its patrons. An illuminating glassware manufacturing concern, which started ten years ago on a strictly illuminating engineering basis, and was the first commercial company to base its operations entirely upon this new science, is at the present time doing a business of more than $1,000,000 a year. One of the two largest manufacturers of incandescent electric lamps in this or any other country has maintained a department of illuminating engineering for several years, and has recently added to its personnel two experts previously employed by the Government. One of the oldest and largest glass shade manufacturers has recently engaged the services of an independent illuminating engineering concern to act in an advisory capacity, and hereafter all its products will be sold on its scientific as well as artistic merits.

These examples will give a fair idea of what has already been done, and what may be expected in the future, of illuminating engineering in connection with the manufacture of lighting devices.

The next important field is furnished by the gas industries. There are over 3000 gas companies doing business in this country at the present time, having a total capitalization of $600,000,000, and turning out a product valued at $80,000,000 annually. From 60 per cent. to 75 per cent. of this product is used for purposes of illumination; and, notwithstanding the remarkable strides that have been made by the electric light since its introduction, somewhat more than a quarter of a century ago, the use of gas for the production of light is steadily on the increase. The gas interests, however, have been curiously backward in availing themselves of the advantages of illuminating engineering. This may be accounted for mostly by their greater age and consequently more conservative tendencies; but this condition will not long remain. Three of the largest gas companies in the country are now definitely using illuminating engineering to a greater or less extent, one of them having taken the matter up since the beginning of the present year. The importance of the subject, and the necessity of utilizing its advantages in order to maintain at least their present parity with other forms of illumination, has been vigorously presented through papers and discussions before their national organizations within the past two years, and by increasing attention to the subject in the technical journals devoted to the industry. There is no more promising field for a competent illuminating engineer than this very field of gas illumination. The mere fact of its more general neglect gives a greater opportunity for those who first enter it.

Another field of usefulness for the illuminating engineer is with the architect.

This is almost unexplored territory at the present time. The architect has been either indifferent or openly hostile to the addition of another engineering specialty pertaining to his profession. Self-interest may account for some of this feeling, the architect naturally being loath to divide his fee with an additional specialist. This condition has been met by New York architects in a general agreement to raise fees from 5 to 6 per cent. Whether this will solve the problem generally remains to be seen, although it is in line with the practice in other professions. The position of an illuminating engineer in an architect's office would be essentially different from any of the other cases we have considered. Undoubtedly, such an engineer would need to be an electrical engineer also, at least to the extent of ability to lay out complete wiring installations. He should, furthermore, have a sufficient knowledge of the principles of architecture, especially with reference to the artistic side, to enable him to appreciate and carry out the ideas of his superior. This knowledge of art and architecture would be an offset to the commercial knowledge required in the other cases we have considered. As much as ten years ago, when illuminating engineering was practically an unknown science, the writer made the acquaintance of one architect whose specialty was churches, who attributed his success largely to the special study which he had given to lighting. There are over 10,000 architects in the United States, but of this number, of course, the large majority are doing business as individuals, and hence must cover the entire field themselves; but even deducting this large majority, there is still a very respectable minority of cases of firms or individuals whose work is sufficiently extensive to justify the employment of an illuminating engineer.

Last in our list of possible fields is that of the illuminating engineer acting either in a purely consulting capacity, or as a constructing engineer. The number of this class at the present time could be counted on the fingers of one hand. This, however, will give no surprise when we consider that there are no institutions turning out graduate illuminating engineers, and that the commercial interests requiring such services are extremely large. As in the case of other branches of engineering, moreover, the proportion of consulting engineers must always remain comparatively small, and success in this particular field must not be expected to come at the first call. The specialist of any kind whose services are sought for must possess a knowledge which is largely the result of experience. We do not pay the tyro for giving us advice. Constructing illuminating engineering offers a larger field and more immediate profitable results. Any electrical contractor or gas-fitter could profitably include this in, or rather superimpose it upon, his present business. There is not one commercial lighting installation out of 100 at the present time that could not be made either more effective in results or more economical in operation, or both, by reconstruction under the direction of a competent illuminating engineer. The size of this field needs no further comment.

Acetylene gas offers another field of what may be called constructional illuminating engineering. What illuminating gas and electricity have done for the city in the way of improved illumination, acetylene seems likely to do for the small town and the country. The field is practically new at the present time, and consequently of enormous possibilities.

Taking this general view of the entire field, there can be no doubt that the young man of to-day who will conscientiously and carefully specialize along some one of the lines indicated will not only find a niche for himself in the great world of commerce, but an occupation full of enchanting interest and possibilities for his mental development as well as a profession also in which a reasonably competent remuneration may be expected.

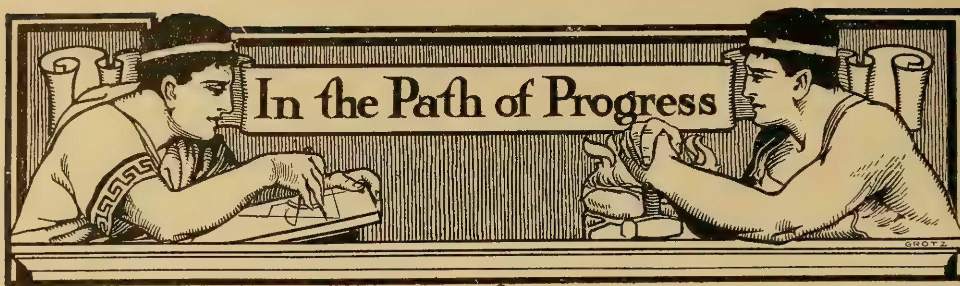
# Gas to Be Taxed in the German Empire

By Max A. R. Brünner.

Although the present and preceding years have been rather prosperous ones in the German empire, the national debt is increasing at an alarming rate, and the Parliament is seriously discussing at present a number of new taxes, of which Germany has already more than enough. Among the proposals made by the Secretary of Finance the tax on gas and electricity will chiefly interest the readers of this journal. There are no less than 31 paragraphs concerning this tax.

Gas producers selling it to other parties have to pay 5 per cent. of the sale price, but not exceeding ½ pfennig per cubic meter; if gas is used for your own requirements the tax is ½ pfennig as long as the maximum heating value is at least 8000 calories for each cubic meter; but if the heat value is less the tax will be only half. No tax is imposed if the gas does not reach a heating value of 1000 calories or is employed in apparatus or machines being in direct contact with the producing plant, such as regenerating furnaces, oil-petrol and alcohol motors. It is clear that the many thousands of gas producers and consumers in Germany have been quite shocked when they first learned of these projects. It is asserted that petrol, the exclusive light source of the flat country and of the poor man, yields an import duty of 70,000,000 marks a year, while the rich man using gas and electric current does not pay anything. It would have been better to impose a tax only for light, but in practice it is almost impossible to separate gas for power and light, and extraordinary expenses for special measuring apparatus, piping and officials would be required.

There exist many municipal gas and electric plants yielding a good profit which is utilized for civic improvements, and a tax will lessen the consumption and injure the city's finances. In later years especially the small business man running a repair shop or factory has used mechanical power to a large extent, also gas or electricity for lighting; he will therefore be greatly handicapped by the tax. There is no doubt that the proposed tax will prevent many a small town or village not yet owning a gas or electric plant from erecting such plants. The project also contains theoretically a great error, for it taxes progress, the refined technics, the better class of lighting apparatus and motors. Consequently if a man is wide-awake and employs a gas engine, he must pay a tax, but if he returns to the old steam power he is free. The originators of the project assert that the tax will be borne, not by the consumers, but by the rich municipalities owning gas plants. It is possible that many plants to escape the many worries will pay the tax, but will also raise the sales price for the gas. To carry the proposal into effect a large number of officials must be employed to inspect constantly the gas and electric works, salesrooms, shops and private residences. This will be a nuisance and besides create an enormous expense for the government. In short, the proposed tax will be a blow to German progress and be bitterly fought by all industries and interested parties.




## A New House Organ

*The Illuminator* is the title of a house organ published by the Tungstolier Company, Cleveland, Ohio, the first number of which bears date of January 15. It is of magazine size, sixteen pages and cover, and is edited by Milton Hartman.

A perusal of the Editorial Section, which begins on the front page, indicates that the editor may be described, in Mark Twain's phrase, as "one who fears neither God, man, nor Lindley Murray."* He might have taken as a motto for his sheet the scriptural text, "Knock, and it shall be opened unto you," as his chief concern seems to be to "knock" illuminating engineering as a science. The character of the publication, however, can be best judged from a few quotations from the "editorial":

"This is No. 1, of Volume I, of *The Illuminator*—the electrical magazine on illumination—issued every month.

"Surely there are journals and magazines galore, but one strictly confined to "illumination"—and its commercial side—is in time.

"*I* quite understand that every pain in the stomach is not a manifestation of genius, but *we* want to make this an original, red blooded, publication.

"Some people never get above *their* mouths, and some never get below *it*.

"*The Illuminator* will be open to all electrical concerns in good standing, on subjects of general interest in the illuminating field."

The italics are ours. Is it innocence, or is it nerve, that has led this editor of a house organ to call his pamphlet "the electrical magazine on illumination," and generously announce that it will be open to all electrical concerns in good standing? Whichever it is, it at least has the merit of being a colossal example of its kind.

Following the introductory editorial is another under the title, "More Light on this Illumination Question." This is a defense on behalf of the Tungstolier Company, by its publicity champion, in regard to certain references in some articles appearing in a prominent trade journal criticising what their writer considered an illegitimate use of illuminating engineering as a mere "talking point" for the sale of lighting fixtures. The rancor shown in this editorial would indicate that the criticisms referred to must have struck a tender spot.

The Editor further says:

"We are informed that the new illuminating movement is a 'sales proposition.' Oh! prodigious perception! Certainly it's a sales proposition. Do you think it's a S. R. O. performance for the firemen's benefit fund? Of course it's a sales proposition."

This statement will, of course, be taken in a Pickwickian sense. After "new illuminating movement," insert "of *The Illuminator*, and no one will question the truth of the statement. That the new illuminating movement which has given rise to the science and art of illuminating engineering, however, is a sales proposition, is precisely the distortion of fact, which the writer of the article Mr. Hartman is criticising took exception to, and to which we decidedly take exception, as must all those interested in the progress of legitimate illuminating engineering. More than any other single factor, or than all other factors put together, is this idea that illuminating engineering is sim-

* Lindley Murray was the authority on English grammar and his name a household word in Mark Twain's boyhood days.

POPPY
No 360 Cleveglass

DOGWOOD
No 363 Cleveglass

RED PEONY
No 369 Cleveglass

TULIP
No 375 Cleveglass

ply a "sales proposition," adroitly used by the manufacturers of lighting apparatus of various kinds to promote their own commercial ends, preventing the recognition of the profession among architects and the public, who are its chief beneficiaries. It is perfectly ethical and legitimate, as we have already pointed out, for business houses and corporations interested in lighting to employ illuminating engineers, and make use of their services in every possible way; but to attempt to degrade the illuminating engineer into a mere "smart Alec" salesman is an affront to the profession which every one interested in its progress will naturally resent. Apparently the editor had an acute attack of pain in the stomach, and this article was the result of an allopathic attempt to get it out of his system.

Following this editorially there are several signed articles by writers—

"Unknown alike to guileless me, to fortune, and to fame."

As advertising "literature," this is worthy of study as an example of what is to be avoided.

It is insincere to begin with, as it attempts to sail under the colors of an independent publication.

It at once puts the company which it represents on the defensive—a position that no competent salesman will ever voluntarily assume under any circumstances.

It attempts to belittle and cast aspersions upon illuminating engineering, the very science which gave rise to the business which it is attempting to promote.

It does not even show ability to use the English language grammatically, let alone convincingly.

Let it be distinctly understood, however, that in criticising this piece of advertising "literature," we are by no means casting any reflections upon the Tungstolier Company nor its product; on the contrary we have previously referred to its product in terms of commendation. The company showed not only originality and the courage of its convictions in being the first to apply illuminating engineering to the combination of the tungsten lamp and fixture design, but has further shown its originality in putting up its fixtures in such a way that they can be readily handled by the dealer in small towns, or even by the consumer himself. There is no question as to the sound engineering principles upon which the fixtures are designed, and their adaptability to the particular class of use for which they are intended. The merit of the article and the progressive spirit of the company being thus, the pity is the greater that they should allow themselves to be put in such an unfavorable light by a misguided publicity department.

## Art Glass in Illuminating Engineering

Any one who has seen even the poorest examples of stained glass does not need to be told the peculiar beauty in color effects obtainable by transmitted light. The most brilliant and exquisite coloring in nature is absolutely unreproducible by representation on an opaque surface, and hence is seldom attempted by artists who appreciate the difficulties. The vivid colorings of the sky at dawn and sunset; the depth and richness of color in water, and even the glories of autumn foliage, are due, not to light reflected from surfaces, but from rays transmitted through the objects seen.

The art of glass painting, which was brought to a high state of perfection in the Middle Ages, simultaneously with a development of the majestic Gothic architecture, has always—and deservedly so—been held in the highest esteem by all lovers of pictorial art; and the examples which still remain are cherished with as much reverence as the masterpieces of painting on canvas. It is probably not generally understood by Americans that the finest colored glass produced in the world to-day, which far surpasses both in delicacy, variety, and richness of color the best products of former ages, is made in our own country. Fortunately, also, its price is such as to bring its use within the reach of the large majority of the people instead of confining its use to the few masterpieces of architecture.

Furthermore, the enjoyment of the beauty obtained from its exquisite color-effects is no longer restricted to the hours of daylight, and the agency of the sun's rays, but may be obtained by artificial

light as well. The feeble light of the candle was not sufficient to either bring out the beauty of stained glass, or to render its use practical from the utilitarian standpoint. The modern high-power light-sources, however, have entirely removed this limitation, and it is by no means an uncommon thing at the present time to utilize artificial lighting for showing the beauty of stained glass windows. The use of stained glass, given an artistic treatment either by the old method of mosaic construction, or by painting, or a combination of both, for coverings for artificial light-sources has been practiced for some time, and offers a wide scope for the exercise of the highest degree of decorative art. On account of the richness and vividness of coloring it is extremely easy to run into the gaudy and the bizarre in its use. Such perversions are happily disappearing, along with the brilliant chromolithograph that flourished a generation ago.

By the courtesy of The Cleveland Window Glass and Door Company, Cleveland, Ohio, we are able to present to our readers some examples which show what may be obtained by the use of stained glass for use with artificial light, in the hands of a true artist. It is both a privilege and a pleasure to further genuine efforts toward placing any art or business upon a higher plane. The examples shown are in themselves sufficient evidence that something more than the mere hope of making a saleable article has been used in their design and construction. We believe firmly with Emerson that "He who will write a better book, preach a better sermon, or make a better mouse-trap than his contemporaries, though he pitch his tent in the trackless forest, mankind will make a beaten path to his door." It takes a certain degree of moral courage and faith to wait for the beaten path to be made—and most Americans prefer to place their shop conspicuously in the haunts of men, that they may gather the dimes and nickels of the passer-by; but there is certainly a fund of satisfaction, and ultimately of financial profit, in doing something better than it has been done before, and waiting for mankind to make the beaten path to your door.

## The Tubular Form of Electric Lamp Adapted to Portable Use

That the tubular form of electric lamp, which is now sold in this country by the trade name of "Linolite," has marked advantages for certain uses will be readily conceded by illuminating engineers. The

"LINOLITE" PORTABLE.

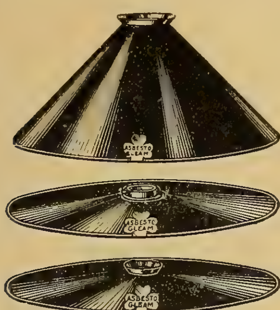
latest special adaptation of the "Linolite" has taken the form of a portable lamp for table and desk use. Its construction is essentially utilitarian, as is clearly shown by the accompanying cut. It is also supplied with the weighted standard without the upright for use on the tops of desks and pianos. The advantages of this arrangement are freedom from the very perceptible and annoying streaks of bright light which result from the ordinary form of incandescent lamp, unless used with frosted bulb, and a more uniform distribution over the usual space which it is desired to illuminate. While no effort is made at purely artistic treatment, the fixture is exceedingly neat and compact in appearance. It is manufactured by the H. W. Johns-Manville Company, New York.

## A New Reflector

A new method of constructing an opaque reflector, designed to take the place of the sheet metal, cardboard and silvered glass reflectors that have heretofore been

used, has just been put upon the market. The method consists in using a thin sheet asbestos, one side of which is coated with aluminum and burnished, and the other enameled green, which is then cut and formed up into cones of various depths, a brass collar and binding completing the construction.

The advantages claimed are lightness, durability and cheapness; all of which points would seem to be well taken. As aluminum furnishes an excellent reflecting surface, and does not readily tarnish, their efficiency should be satisfactory. They are sold under the trade name of "Asbesto-Gleam," and are made by the Asbesto-Gleam Mfg. Company, Philadelphia.



TYPES OF ASBESTO-GLEAM REFLECTORS.

## Another New Portable With Merits of Its Own

We have always been outspoken in our advocacy of individual lighting where careful eye work must be done. The advantages of this system need not be reviewed here, as they are now generally accepted. The problem is a mechanical one of finding the most convenient means of supporting the special or individual light-source. A solution of this problem, with merits which are readily apparent from a glance at its construction, is shown in the illustration. This consists of an exceedingly light and convenient portable stand designed to rest upon the floor instead of upon a table, as has been generally the case heretofore. This enables the light to be placed exactly where wanted, while the reflector shade can be so adjusted as to light the work while completely screening the eyes. The device is certainly simple and effective, and adaptable to many cases of illumination. It is made by the Vote-Berger Company, La Crosse, Wis.

BADGER PORTABLE LIGHTING UNIT.

BADGER PORTABLE IN USE.

# Proceedings of Technical Societies

## The Commercial Illuminating Engineering Division of the Boston Edison Company[1]

By Herbert W. Moses.

The object of this paper is not so much to relate the work accomplished and successes gained by the engineering division during the three months of its existence as it is to point out the importance and magnitude of the work being undertaken, and, perhaps most important of all, to awaken new ideas pertinent to the subject, together with the interchanging of such ideas in the discussion to follow.

It is unnecessary to take the time here to comment upon the marvelous growth of the industry during the past ten years. The improvements have been marked and have appeared in rapid succession. The small type of engine with belted generator has been replaced by the vertical cross-compound type of engine directly connected to generators. The ratings of generators have grown almost beyond comprehension until finally there has appeared the steam turbine coupled to generators of enormous rating and high voltage. Considerable improvement has also been made in methods of distribution, transformation and in the measuring of energy.

Accompanying all these improvements there has been a consistent reduction in rates, and yet, during all these ten years, with very minor improvements, use has been made of the self same carbon lamps.

To be sure the question of more economical lamps has received most careful consideration from the manufacturers for a considerable time, but when the years of supremacy of the carbon lamp are considered it is only a comparatively short time since the introduction of a lamp whose specific consumption was lower than 3.1 watts per candle.

The Boston Edison Company was among the very first, if not the first, to appreciate the value of an economical lamp, both as to its bearing on prospective as well as existing business. There was unanimity of opinion among the management that the new types of lamps would revolutionize the lighting industry, and there was no hesitation regarding the immediate adoption of the new lamps. It was believed that the reduction in rates, combined with the economical lamps, placed electricity within reach of all; a tremendous field for new business opened up and efforts were made forthwith to get that business.

As to the existing business, doubtless all are agreed that in the past far too little attention has been paid to the method of illumination. From the architect's viewpoint, very little care has been given to the arrangement of fixtures, the usual centre outlet has been provided with a few wall outlets dotted here and there, and the plans in this condition have been passed on to the contractor for estimates. The question of illumination has occupied last place, and in many instances the entire design for important buildings has been left to draftsmen or mere office boys. Moreover the situation has not been much

[1] A paper read before the New England Section of the Illuminating Engineering Society, December 3, 1908.

better from the wiring contractor's and fixture manufacturer's point of view.

As a result of the varied opinions regarding illumination, the customer has suffered considerably in the past simply because of having too little light on account of poor arrangement or too much light even with a good arrangement. Both of the above conditions have wrought a hardship to the customer, as neither resulted in economy.

The above comments should not be considered as disrespectful to either architect or contractor. It was for the very object of uniting the interests of the architects, the contractors, the customers, both existing and prospective, and the Edison Company, that the division of commercial illuminating engineering was formed. It was sought by this method to bring about an amalgamation of forces to produce the satisfied customer. This division is used for advising and assisting customers to use electricity most efficiently. In presenting suggestions only the customers' interests are kept in mind, as the effect of the suggestion upon the company's income is of only secondary consideration. The prime requisite is to have satisfied customers.

Working along the lines that one pleased customer makes ten new ones, it is easy to see how the company expects to offset the decreasing income brought about by the reduced rates and recommendations for greater economy in the use of energy.

The scope of the commercial division is very broad. It will design the entire illumination of any new building, the only requirement being the permission of the architect to do so. It will undertake the design of the lighting in buildings being remodelled—with the architect's consent. It will, upon application of any existing customer, and after careful consideration of the conditions, submit to him suggestions for obtaining more light for the same money, or the same light for less money, just as the customer may desire. It does not always wait for the customer to ask for such information, the agents who are on duty at night being always on the watch for poor and costly installations; these cases are reported directly to the division and notes pointing to greater economy are prepared and forwarded to the customer. Then, too, the collecting force keeps the division advised of customers who complain of their bills, and also of any cases which in their judgment could be improved. Moreover, reports are sent in by the district agents, who are daily in touch with customers and with conditions in general throughout their districts.

The plans for the formation of the commercial illuminating division were completed in April and two representatives arranged to spend the summer in Europe in studying the latest and most improved methods of illumination.

As a preliminary announcement to the customers of the plans under way, a letter explaining the advantages of the tungsten lamp was sent out from the president's office to every customer on June 3.

On July 15, a series of advertisements were begun in the Boston papers relative to the opening of the commercial illuminating division on September 1 for the benefit of Edison customers. These advertisements, fifteen in all, which were published from time to time up to September 1, kept the public in touch in a general way with the policy of the illuminating division and the progress of the representatives abroad.

On September 1 a second letter was sent to every customer from the general superintendent's office calling especial attention to the fact that the commercial illuminating engineering division was ready for business and soliciting customers' inquiries on illuminating matters.

The results of the summer advertising were very gratifying. Many congratulatory letters were received commenting upon the company's progressiveness in this undertaking, but doubtless the greatest compliment was by having other lighting companies appreciate very quickly the importance and wisdom of the undertaking, to the end that they immediately adopted the methods of advertising and formed illuminating engineering divisions of their own.

It may be of general interest to explain the organization of this division and to state something of its methods of handling business. The company secured the services of Dr. Louis Bell as consulting expert. In addition to Dr. Bell there are four

others who attend to the details. The applications from whatever source they may originate are transferred to a small card together with such information as may be necessary regarding the party to be seen, time of appointment, etc. These cards are designated numerically and applications are attended to, as far as possible, in the order in which they are received. Spaces are provided on the card to note details of the customer's premises with special regard to size of room, color scheme and full description of the present method of illumination, whether gas or electricity, the type of gas burners in use, also sizes and type of all electric lamps and kind of shades. All of these data are obtained by an inspector, and a sketch is made for showing the present arrangement of fixtures and their relation to each other. Peculiar conditions are carefully noted, as are also the inspector's own impressions of the situation. He usually makes no suggestion while on the premises but simply obtains from the customer the point from which he wishes the matter viewed, whether it is desired to obtain more light for the same money or the same light for less money.

The complete reports, which are turned into the office every night, are reviewed by the consulting engineer as soon as possible thereafter. In the more difficult cases the consulting engineer visits the premises himself and plans the scheme while there or collects sufficient data for more careful subsequent study.

A written report is sent to each applicant for explaining in considerable detail the changes necessary to bring about the required results. Prices for these changes are sometimes quoted, although as a general rule no quotation is given, as it is not desired in any way to interfere with the business of the wiring contractors. The aim is to make the reports clear and to the point, so that the customer can turn each report over to a contractor and receive his estimate in the least possible time. The cards and copies of reports are filed for future reference.

The division has been a success from the start, more than 450 applications having been received during the three months that the work has been under way. More than 400 reports have been sent out and the balance are in process of investigation. Besides the applications referred to above there have been many office and telephone calls which, although pertinent to the subject, required no special report, and thus no records of these calls have been made.

The tungsten lamp is a very important factor in the recommendations made by the division. The lamp, although comparatively new, is already so well known that it is unnecessary to comment here upon its many good points, except to say that it is giving general satisfaction and the greatest trouble to date is that the lamps cannot be obtained fast enough from the manufacturers.

The tendency in the past to use lamps without shades has proved difficult to overcome, perhaps not quite as serious, however, as it has been to influence the customer to do away with his present type of inefficient shades. Careful investigations have been and are being made of the various makes and types of shades that appear on the market from time to time, and the suggestions regarding use of them are very varied.

It is believed that the best shade to produce the desired result is the one to be recommended, regardless of who the maker may be. We are all agreed that to produce the best results all lamps require some type of shade and the question of the proper type is a matter which deserves careful consideration because many otherwise commendable installations have been spoiled by using improper shades.

From another viewpoint the lighting sources of to-day, whether they be the tungsten lamp or the Welsbach mantle, are of such intense brilliancy that the harmful effect upon one's eyes must not be overlooked, and the proper shading of such lighting sources gives rise to problems of no little moment. It will be no small task to convince the customer that he can obtain more efficient and better distributed illumination from well-shaded lamps placed out of range of the eye than he can from the great glaring lamps that have been placed directly in the line of vision heretofore.

The offering of suggestions is carried on with great caution. If a review of the situation shows that the tungsten lamp is not advisable in the particular instance, its use is promptly discouraged. It is not

the wish to have the customer spend money unwisely, and if changes cannot be suggested for his benefit he is told so very frankly. In fact there have been several cases where other types of lamps have been suggested and a few cases where no change at all was deemed advisable. There have been cases where the premises have not used an adequate amount of electricity, but it has been only with the full permission of the customer that any recommendations have been made calling for an increase in energy consumption, as the work of the department is along the line of reducing the energy or keeping it the same.

In general the use of tungsten lamps is advocated in any place where a Welsbach mantle can be used, as each will withstand about the same amount of vibration. The flexibility of electric lighting makes it possible to produce some very pleasing and artistic effects by bringing the lamp very near the objects to be illuminated; in this way satisfactory results have been produced in show-case and window lighting, as well as many decorative effects in art glass shades, domes and portable lamps.

There is so much valuable printed matter regarding the method of procedure in illuminating engineering that it seems unnecessary for the writer to discuss here the various means by which certain conclusions have been reached. Moreover, it would be extremely difficult to lay down any fixed rule, for it often develops that each case has its special requirements and has to be considered from purely local conditions. In the cases of rearranging existing installations the ideal condition is rarely ever attained, principally on account of the expense necessary to bring about this condition. However, the interested customer will, as a rule, accept the suggestions with certain modifications and will gain considerable benefit by so doing. The illuminating engineer should not be discouraged because he has not accomplished all that he had set out to do, he has really done a very creditable job in bringing about something that has never before existed and perhaps most important of all he has advanced a bit more the campaign of education and has gained the customer's stamp of approval to this profession which is bound to receive recognition among the other professions of the world.

An illuminating engineer to be successful should have the element of good judgment developed to a marked degree, as the results obtained in very many cases are estimated more in good judgment than in foot-candles.

The results obtained thus far are very satisfactory, already more than 15 per cent. of the reports sent out having been accepted and the changes completed. It is rather interesting to note the classification of applications, and there follows a classified list of those received during the past three months:

| | |
|---|---|
| Stores | 162 |
| Offices | 75 |
| Residences | 66 |
| Saloons | 15 |
| Publicity office buildings | 23 |
| Factories | 13 |
| Churches | 19 |
| Clubs | 12 |
| Restaurants | 8 |
| Stables | 5 |
| Theatres | 4 |
| Hotels | 3 |
| Bowling alleys | 2 |
| Post offices | 3 |
| Banks | 2 |
| Libraries | 2 |
| Total to date | 414 |

Both new churches and old have applied and several have already substituted electric lamps for other illuminants. The church business is good in spite of the fact that the income is comparatively small. The soft and artistic lighting effects appeal to the people as does the readiness with which electricity can be used for the organ blower, the ventilating fan, for radiators in the parlors or vestry, and for the indispensable range in the church kitchen.

The Boston Edison Company was the pioneer in the formation of a commercial illuminating division and the success of the enterprise to date has equalled expectations. The customers have been most eager to avail themselves of the tungsten lamp, and up to December 1, there have been sent out 8,066 25-watt, 6,997 40-watt, 6,737 60-watt and 11,476 100-watt lamps, a total of 33,276 lamps, which is more than the combined total of all of the other large Edison companies in the country.

There remains to be discussed only what it is hoped to accomplish through the work of the division.

That there is need for illuminating engineers cannot be denied. The use of arti-

ficial illumination to-day is of primary importance, because a considerable portion of the world's work is done at night or in places which, even in daytime, require artificial light.

To keep abreast of the times the illuminating engineer must be alert, he must be a man who does things unhesitatingly, for he will find many troublesome obstacles to be overcome. In the first place the suspicion of the customer is often aroused at the very start by the initiative taken by the company in offering suggestions to bring about a reduction in bills. The ordinary customer is not far-sighted enough to appreciate that it is for the company's best interest to have satisfied customers and maintain friendly relations with them; he does not understand that reducing bills by the scientific application of the principles of illuminating engineering is the very best way to promote these friendly relations between customer and company which, in the long run, result in a steady and healthy growth of the industry.

Economy seems to be the foremost requirement of the business world to-day. This fact is seen from the analysis of applications received; a large percentage desire lower bills, some want better light at no greater cost, while only a few want more and better light regardless of cost.

It is hoped especially to co-operate with the architects and contractors so that all may work together for the mutual benefit of the customer and the company. It is desired to make the architect see the fallacy of adopting such a scheme of lighting as has recently become quite universal for residence lighting, namely, the general use of wall brackets to the exclusion of other devices. There seems to be no good reason for this method being so much in favor, except perhaps from an artistic viewpoint. Bracket lighting is extremely expensive, and there should be established some rules that will define more clearly than at present the point at which the artistic may be sacrificed for the practical and commercial side.

It is the desire to co-operate with the contractors because they occupy a very important position in undertakings relative to illuminating principles. It is most often the contractor in the case of small installations who designs the lighting scheme, because as yet it has not become the general custom to consult an illuminating engineer on matters of minor importance. Unless the contractor follows along the line of good illuminating engineering practice then the lighting company's efforts to educate its customers are of no avail.

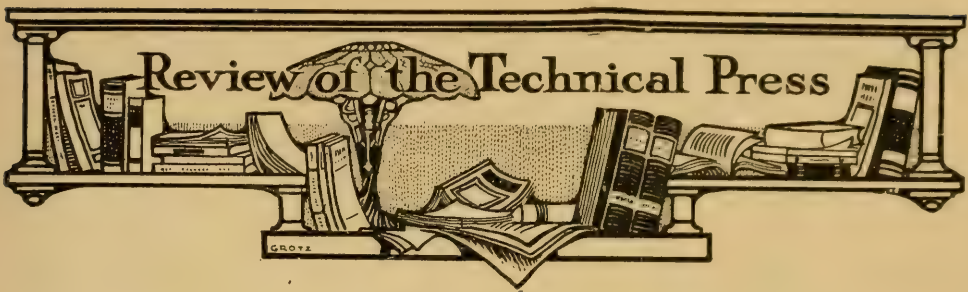
Above all it is the desire to secure the confidence of the customers and to make them feel that the suggestions made are for their best interests. As a rule the customer is intelligent, fair-minded and inclined to be friendly. It is a pleasure to promote and retain these friendly relations. The wish is to have the customer know that he is entitled to the same courteous treatment from the company as he may rightfully expect from any first-class merchant.

## The Commercial Value of Better Public Lighting

The spread of the movement for better public lighting is progressing with increased momentum. The latest city to fall into line is Philadelphia. As in most cases, the movement toward the general improvement of public lighting received its first impetus from a merchant's association. From this it was at once taken up by the daily newspapers, the *Press* devoting special attention to its promotion. As a result of the agitation, Mayor Reyburn has recommended the city councils to take action in the matter. In his message he says:

May I call your attention particularly to the beneficial influence such a development will have, not only on the life of our city in stimulating business activity along the streets named, but the great service it will render in placing an additional safeguard around the millions of dollars' worth of property in that district. It will, as is stated, certainly make the main thoroughfare more attractive not only to our citizens, but in addition create a different impression on the minds of visitors to Philadelphia.

The era of dimly lighted streets has passed, and as all great cities are devoting more and more attention to the problem of adequate street lighting, Philadelphia should not be backward in any movement that will directly result to the betterment of the city as this will. Increased light means increased attractiveness and enhanced property values, and greater revenue from property tax. I, therefore, request your consideration of this request.




# American Items

Illuminating Engineering vs. Common Sense, by Basil G. Kodjbanoff; *Electrical World*, January 21.

The writer holds up to scorn all pretenders to the title of illuminating engineer whose only claim is a purely business connection with some commercial interest dealing with illumination, and, while common sense and electrical engineering, or architectural training will generally produce better results than are shown by the would-be illuminating engineer, there is nevertheless a sufficient field for a specialist in this line, but that such specialist have adequate training before claiming title as illuminating engineers.

Street Illumination in Newark, N. J., by Wm. H. Stuart, *Electrical World*, January 28.

A description of the installation of flaming arcs and festoons of incandenscents recently erected on a portion of Broad street, Newark.

Street Lighting in Rio de Janiero, by A. H. Keleher; *Electrical World*, February 11.

An illustrated article describing the public lighting in the Brazilian metropolis.

High-Efficiency Lamp Renewal, by J. F. Musselman, Jr.; *Electrical World*, February 11.

A valuable feature of the article is a table showing the cost of energy and renewal per 1000 hours of a 32 c.p. 3.5 watt carbon filament lamp; a 32 c.p. 3.1 watt carbon filament lamp, and a 32 c.p. 1.25 watt tungsten lamp at various cost prices of energy from $.002 to $.125 per k.w. hour.

From this table it appears that for any ordinary installation where either a carbon or tungsten-filament lamp can be used the short-lived 3.1-watt carbon-filament lamp is never a good investment, for, however cheap or however costly the electric energy may be, either a long-lived 3.5-watt carbon-filament lamp or a tungsten lamp gives a lower total cost per 1000 hours. Hence, a 3.1-watt lamp is no longer to be considered except in cases where the lamp breakage is very high or the vibration is so great as to shorten the life of the tungsten filament, or where some other local condition makes the use of this filament inadvisable, and then only when energy costs more than 1.6 cents per kw.-hour, for at any lower rate the 3.5-watt lamp is a better investment.

Some Tungsten Lamp Lessons, by H. H. MacPherson; *Electrical World*, February 11.

Discusses the relation of the tungsten lamp to the commercial side of the central station. The writer says that the tungsten lamp brought its problems, but it has not brought the expected decreases (in revenue). The central station man should take heart and say, "I have been looking for something like the tungsten lamp for years, and am glad now that it is here."

Illuminating Engineering vs. Common Sense, by A. J. Marshall, *Electrical World*, February 11.

A reply to Mr. Kodjbanoff's article of

the same title in the *Electrical World* of January 21.

Illumination Calculations Simplified, by T. W. Rolph; *Selling Electricity*, January.

The writer says that in electric lighting the problem of obtaining general illumination can be simplified by dividing it into three steps: First, select the foot-candle intensity desirable; second, determine the watts necessary to give this intensity; third, arrange the lights in such a way that the illumination will be uniform. The table of the different intensities required for different purposes is then given; also a table of the watts per square foot required for various lamps and reflectors under different conditions. Finally, the distrubution of the watts is discussed.

Window Lighting, by Norman Macbeth; *Dry Goods Economist*, January 30.

Continuation of the series of articles on illuminating engineering, which has been appearing in this journal. The article contains many facts and figures with illustrations of good and bad installations with both gas and electric light.

Laying down the general principles of window lighting, Mr. Macbeth says:

The problem of window illumination has two sides—the physical and the physiological. The window may have the right kind of lamps, the correct amount or quantity of light, but, because of the physiological effect, may be condemned. Many installations waste light in outline effects, by studded ceilings and other methods which, if used properly, would efficiently do the work and leave a fair amount to charge off on the investment. The sense of seeing is dependent upon differences in the intensity and quantity of illumination reflected from the goods to the eye of the observer.

Some Phenomena of Persistence of Vision, by Frank Allen; the *Physical Review*, January.

A highly technical discussion of the subject.

# Foreign Items

Compiled by J. S. Dow.

## ILLUMINATION AND PHOTOMETRY.

The Internal Lighting of Churches, by G. A. T. Middleton (*Illuminating Engineer*, London, January).

The Illumination of Churches (*Illuminating Engineer*, London, January).

The Lighting of Churches by Acetylene (*Illuminating Engineer*, London, January).

The Illumination of the Church of Santa Sophia, Constantinople, by J. B. Fulton (*Illuminating Engineer*, London, January).

The above articles form a portion of the special section of the London *Illuminating Engineer*, for January, devoted to Church Lighting.

While it is impossible to review the ground covered in any detail, it may be said that in general the question is raised, What ought the object of light in churches be? They must perform a number of purely utilitarian purposes and must therefore be placed so as not to be offensive to the congregation; but there are also æsthetic and religious aspects of the matter to be borne in mind, and we may justly inquire, how far, in the case of buildings of the venerable and ancient character of Westminster Abbey, for instance, we are justified in having to resort to the illuminants of the present day. On the other hand, it may be pointed out that such buildings and their contents are of na-

tional importance and therefore the system of lighting adopted, whatever it be, ought to be carefully considered.

Much depends on the nature of the religious worship to which churches are dedicated, and illustrations of Protestant, Catholic and Jewish places of worship make it clear that very different conceptions as to the nature of the illumination suitable prevail. Thus, in a Jewish synagogue of note wax candles are exclusively employed; in the Church of Santa Sophia, described by Mr. Fulton, on the other hand, tiny oil lamps are used. In such cases it is questionable whether traditions and religious scruples would permit of modern methods of illumination, even if imitations of ancient conditions were resorted to. Any such attempt at imitation would, in any case, call for a special degree of taste on the part of the illuminating engineer.

Lux or Meterkerze? by L. Weber and B. Monasch (*E. T. Z.*, January 14).

Two letters from Dr. B. Monasch and Prof. L. Weber respectively have appeared in the *Elektrotechnische Zeitschrift* respecting the merits of the above two terms to denote the unit of illumination. Monasch is still in favor of the term lux, which he considers shorter, more convenient, in more general use, and better adapted for international use. Professor Weber, however, still argues that it is hopeless to strive for an international unit of illumination until a standard of light is agreed upon; meantime he thinks the Hefnermeterkerze is even more generally used in Germany than the lux, and, for the time being, more intelligible to every one.

Besides this main question, the letters enter into the exact meaning to be attached to Cohn's famous figures for the minimum of hygienic illumination, which, however, cannot be discussed here.

Licht-therapie und praktische Elektrotechnik, by O. Vogel (*E. T. Z.*, January 14).

A discussion of the effects of different portions of the spectrum on the human organism, and the best methods of producing artificial light of any desired frequency. The author restates his impression that it is the visible blue waves to which curative powers are to be ascribed, and not the ultraviolet ones.

Editorial, Influenza dei raggi ultravioletti sull'organo vista (*L'Elettricita*, December 17, 1908).

A *résumé* of the effects of ultraviolet light on the eyes as discussed by Schanz, Stockhausen, and Voege. (See previous reviews.) It is pointed out that Holophane globes, besides distributing the light, must be effectual in absorbing any ultraviolet energy, which might be considered dangerous.

The Production and Utilization of Light, *by A. P. Trotter* (Continued; *Illuminating Engineer*, London).

The present section describes some forms of the Ritchie Photometer, and discusses some practical details on which the sensitiveness of such instruments depends.

Beleuchtungskörper für konstante Boden-und Raumbeleuchtung, by E. W. Weinbeer (*Z. f. B.*, January 17).

A study of sources and reflectors intended for the production of a uniform ground-illumination, etc.

Kostenvergleich verschiedenen Beleuchtungsarten, by E. W. Weinbeer (*Z. f. B.*, January 17).

Brief comparison of the cost of producing a given illumination for a given time by various illuminants; on this basis petroleum-lighting, usually regarded as cheap, works out dearest, taking into account the light produced by a given consumption.

An Apparatus for Studying the Color of Artificial Illuminants, by W. Voege (*Illuminating Engineer*, London, January, 1909).

Describes a method of comparing the degree of incandescence of illuminants by the deflection of a thermopile exposed to their rays and screened alternately with red and green glass respectively.

The Production and Utilization of Light, by Dr. C. V. Drysdale (Con-

tinued; *Illuminating Engineer,* London, January, 1909).

THE LUMINOUS EFFICIENCY OF A BLACK BODY, by Dr. C. V. Drysdale (Paper read before the Physical Society, January 22).

The author shows how the radiation of an illuminant of the "black body" variety changes with temperature and deduces the greatest possible luminous efficiency of an incandescent body of this type to be 50 per cent.

ILLUMINATION AND ILLUMINATING ENGINEERING (*Elec. Engineer,* January 1).

REFLECTIONS ON LAMPS (*Elec. Rev.,* January 8).

ELECTRIC LIGHTING.

THE METALLIC FILAMENT LAMPS IN THE UNITED STATES, by Dr. Louis Bell (*Times Engineering Supplement,* January 6).

A readable article contrasting the condition of things in Europe and the United States. Chief among the conditions absent in Britain are the facts of the lamp industry being in the hands of a few large companies and the active part taken by supply companies in the sale of lamps to consumers. In addition the prevalent supply P. D. in the United States is only rarely as high as 220 volts, which, of course, is a material assistance to the metallic lamp. Results with the tungsten lamps in the United States Dr. Bell states to be satisfactory, but the protection of the eyes from their increased brilliancy requires attention.

FÄDEN FÜR ELEKTRISCHE GLUHLAMPEN AUS RUSS UND CHINESISCHEN TUSCHE, by Ritterburg and Hermann (*Z. f. B.,* December 30).

Refers to some experiments with the object of constructing glowlamp filaments out of lampblack and Chinese ink; the results so far obtained are satisfactory, filaments capable of yielding a life of 1000 hours at 1 watt per H. K. being obtained. This report is interesting in view of the statement of some authorities that the filament of the future will consist of some homogeneous and allotropic form of carbon, free from the disadvantages of the ordinary material.

METALLFADENLAMPEN FÜR 220 VOLT (*Z. f. B.,* January 10).

Describes some tests on a set of metallic filament 220-volt lamps by different makers. It is interesting to observe how many firms now make lamps for these high pressures. The results of the tests seem rather irregular, the specific consumptions of the different makers varying from about 0.8 to 1.6 watts per H. K.

UEBER DAS REGULIEREN DER BOGENLAMPEN MIT SCHRAGEN KOHLEN UND BLASMAGNETEN, by J. Teichmuller (*E. T. Z.,* December 17, 24; *Jour. f. G.,* December 24; *Elec. Engineering,* January 7).

Describes a series of experiments upon the regulation of flame arc lamps. The author points out that the regulation of lamps of this kind depends upon essentially different data from those affecting the ordinary kind; for instance, their action is modified by the presence of a core in the carbons and want of homogeneity generally. One interesting conclusion arrived at is that the theory of the arc being repelled and flattened out by the blowmagnet is incorrect.

MODERN ARC LAMPS AND THEIR APPLICATIONS, by J. Rosemeyer (*Ill. Eng.,* London, January).

METALLISCHE LEUCHTFÄDEN UND METALLFADENLAMPEN, by B. Duschnitz, in *Der Febrikation und in der Praxis* (Continued) (*Elek. Anz.,* Dec. 20).

GLÜHLAMPE MIT MEHREREN FÄDEN, by J. W. Phelps (*Z.f.B.,* Dec. 30).

NEUERE VERBESSERUNGEN DER MAGNETITBOGENLAMPE (*Z.f.B.,* Jan. 10).

THE ECONOMICAL POSSIBILITIES OF LIGHTING BY CARBON FILAMENT LAMPS (*Ill. Eng.,* London, January).

DIE NEUESTEN FORTSCHRITTE DER BERLINER STRASSENBELEUCHTUNG IN VERGLEICH MIT DER BISHERIGEN BELEUCHTUNGSARTEN, by H. Drehschmidt (*J.f.G.,* Jan. 16).

The author criticises the recently published article of Dr. L. Bloch on the above subject, claiming that he does not correctly estimate the recent progress of gas lighting. For instance, the high pressure inverted gas lights in use now consume not 0.65, but only 0.48 to 0.5 litres per M. Lower Hem. Sph. C.P. Professor Drehschmidt also points out that Dr. Bloch's own figures suggest that the flame arc lamps must act very unevenly, some apparently yielding a much higher illumination immediately below them than others.

INTENSIV-GASBELEUCHTUNG MIT PRESSGAS UND MIT PRESSLUFT, by O. Klatte (*J.f.G.*, Dec. 20).

A further addition to the discussion as to the relative merits of using high-pressure air and high-pressure gas. The author again states that the Pharos Company, who utilize lamps in which both methods are employed, find the former method preferable.

STREET LIGHTING IN SMALL URBAN DISTRICTS, by E. F. Willson (*J. G. L.*, Jan. 12).

The author gives his experiences in lighting a small district by gas. Among many matters discussed, the author's figures for mantle-renewal, 5½ per lamp per annum are interesting. In the discussion, Mr. Boot remarked on the lowness of these figures, suggesting that, on a windy night, as many as 75 per cent. of the mantles might be put out of action. The same speaker declared that he had never been able to obtain more than 35 candles from an ordinary gas-burner, taking 3.5 cu. ft. per hour, though initially, and with special conditions as regards quality of gas, &c., 70 were said to be obtainable.

TOWN-GAS FOR RAILWAY LIGHTING (*J. G. L.*, Dec. 29).

Gives some particulars of railway-carriage lighting in the Isle of Wight by gas compressed at 150 lb. per square inch, which, it is claimed, exceeds oil-lighting in cheapness. During a run of 23 days, 4 out of 19 mantles were replaced.

ERFAHRUNGEN MIT LATERNEN-FERNZÜNDUNGSAPPARATEN, by H. Dobert (*J.f.G.*, Jan. 16).

Describes some experiences of the Bamag distance gas lighter during six months, a saving of 36 per cent. of the cost of attendance to lamps in the streets was achieved.

AUTOMATIC STREET LIGHTING IN LIVERPOOL (*J. G. L.*, Jan. 12).

Also gives some particulars of various methods of distance-control of gas lamps.

THE FOULING OF ACETYLENE BURNERS (*Acetylene*, Dec., 1908).

The fouling of burners may be due to either mechanical, chemical or physical impurities; one common cause, however, is the formation of inconvenient polymerides of acetylene, and these are usually derived from the impurities of other kinds already present such as phosphoretted hydrogen.

Other articles:

L'ETAT ACTUEL ET L'AVENIR DES DIFFERENTS MODES D'ECLAIRAGE (*Rev. des Eclairages*, Jan. 15).

METALLIC FILAMENT LAMPS, by Dr. L. Bell (*G. W.*, Jan. 9).

PETROL-AIR GAS, by W. Key (*J. G. L.*, Jan. 12, Corresp.).

'ROUND THE WORLD, AND SOME GASWORKS, by J. Graham (*J. G. L.*, Jan. 5, Jan. 19).

BUISSON-HELLA ET ACETYLENE, by L. Protais (*Rev. des Eclairages*, Jan. 15).

THE LIGHTING OF FLEET STREET (*G. W.*, Jan. 2).

INVERTED GASLIGHTING, OR METALLIC ELECTRIC LAMPS FOR STREET LIGHTING (*J. G. L.*, Jan. 12).

PORTABLE ACETYLENE LAMPS IN MINES (*Acetylene*, January).

VERFAHREN ZUM ZEICHNEN VON GLÜHSTRUMPFEN . . . GLÜHLICHTBRENNER FÜR FLÜSSIGE BRENNSTOFFE (*Z.f.B.*, Jan. 20).

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* *Contractions used.*
*E. T. Z.* *Elektrotechnische Zeitschrift.*
*Elek. Anz.* *Elektrotechnischer Anzeiger*
*G. W.* *Gas World.*
*Ill. Eng. Lond.* *Illuminating Engineer (of London).*
*J. G. L.* *Journal of Gaslighting.*
*J. f. G.* *Journal für Gasbeleuchtung und Wasserversorgung.*
*Z. f. B.* *Zeitschrift für Beleuchtungswesen.*

# Miscellaneous News

BERKELEY, CAL.—Plans have been completed by the Conference Committee of the Berkeley improvement clubs for the waging of an active campaign for better street lights. It will be asked that the current be reduced in Berkeley from 220 to 110 volts. It is said this will remedy many of the present troubles. It is thought that if enough influence is brought to bear the Berkeley Electric Lighting Company will comply with the wishes of the people. According to H. A. Sully of the Northill Improvement Club all modern improved incandescent lights are made exclusively for a 110-volt current.

WASHINGTON, D. C.—Chairman Green of the Committee on Illuminations for the inauguration has submitted plans for the lighting of the Capitol, the monument, the post office, the Treasury front, Pennsylvania avenue and the peace monument, where sprays of water, illuminated by various colored lights thrown upward from the base, will envelop the statue. To the southeast of the Treasury Building, and directly in line with the avenue illuminations, it is proposed to erect a brilliantly lighted arch, bearing the names of Mr. Taft and Mr. Sherman, and an American flag, illuminated by colored searchlights, will float from the top of the arch.

ST. LOUIS, MO.—The Committee on Design and Electrical Supply of the Downtown Lighting Association will complete a definite plan for lighting the streets in the business section, and one for considering bids for the work will be presented to the Board of Public Improvements for its consideration when the new lighting contracts are opened. Many sessions have been held and an agreement has about been reached as to the form of lamp and standard to be installed in the district. In addition, a subcommittee has mapped out a comprehensive lighting scheme which, when installed, will transform the business section into the most modern and best lighted section of any city in the United States.

NIAGARA FALLS, N. Y.—Those who have been advocating the renewal of the project for lighting the Falls are encouraged. Prominent traffic officials representing the New York Central lines were consulted and they expressed themselves in favor of the illumination scheme.

It will require an expenditure of more than $30,000 to permanently install the gigantic searchlights and other equipment for the illumination, and the city depends in a great measure on help from the railroads. In September, 1907, the lights were on for a month, and the Falls at night were transformed into a spectacle of surpassing grandeur, with the vari-colored rays from the projectors. Some of the searchlights were the biggest in use at the time, exceeding in size the largest on the United States men-'o'-war.

The railroads appreciate that with a permanent illumination a further attraction would be offered to those contemplating Niagara Falls excursions. The special tourist traffic into this city during the summer is tremendous. With the illumination it could be doubled, say the wise ones, and for that reason the railroads are expected to define their position ere long.

WHEELING, W. VA.—The maintenance of the city gas plant, that at present is attracting so much public interest, is a matter of grave importance to the public. Especially is this true since the citizens themselves endorsed municipal ownership of the gas plant by passing a bond issue of $110,000 to improve it.

The gas trustees are making every effort to get plans in shape for the improvement of the city gas plant, and are only waiting to hear the final result as to the disposition of the improvement bonds. Communications are being made ready for sending to different cities of the country and to corporations as to their experience in the making of gas and the facts will be collected as far as possible regarding the fuel used for the product, whether coal oil, gas, or both.

Exact figures as to the candle power of the products and the cost in holders will be ascertained, as also the charge to the consumers.